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ABSTRACT

This curriculum is designed to provide training in skills used by technicians and foresters throughout the world who plant, care for, and harvest trees. It contains 16 units. Each instructional unit includes some or all of the basic components of a unit of instruction: performance objectives, suggested activities, handouts, information sheets, supplements, transparency masters, activity sheets, assignment sheets, assignment sheet answers, job sheets, practical tests, written tests, and written test answers. Units of instruction are designed for use in more than one lesson or class period of instruction. Introductory materials include information on teaching basic skills. Units cover the following topics: explore the world of forestry; investigate career opportunities in forestry; identify forests and forest products; determine patterns of tree growth and classification; identify forest trees; practice forest safety; identify and use the basic tools of forestry; use basic math for forestry; practice tree measurement; use basic surveying techniques; use legal land descriptions; cruise timber stands; apply forest management practices; identify forest fire protection practices; identify insect, disease, and natural damage to the forest; and apply forest utilization practices. (YLB)

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Forestry

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CIMC

Teacher Edition

Oklahoma Department of
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1500 West Seventh Avenue
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Forestry

Developed by the
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FOREWORD

As agricultural education in Oklahoma continues to expand traditional production agriculture courses with specialized curriculum offerings, students are just as likely to be found in the laboratory as in the shop. The purpose of a field trip to a packing house may be to study packaging machinery and techniques as well as to evaluate carcasses. A field trip to a successful greenhouse operation may be to study display and marketing strategies as well as propagation techniques.

By providing these additional educational opportunities, today's students are better prepared and are more knowledgeable about the career opportunities that await them.

This diversity also promotes the selection of curriculum to match local industry. The wood products industry is a vital segment of the economy in the southeastern section of Oklahoma. This curriculum has been designed to provide students with basic knowledge and skills that can lead to job opportunities and future employment.

Edward A. Smith, State Supervisor
Agricultural Education
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and Technical Education

PREFACE

Every year the land available for commercial timber production grows smaller, with thousands of acres being taken for the construction of highways, homes and other commercial uses. The demand for wood and wood products continues to grow. Today, approximately 5,000 products are being made from wood including chemicals, pharmaceuticals, and clothing in addition to lumber, paper and traditional wood products.

The forest products industry will continue to need skilled workers including engineers to design and develop specialized equipment, biologists to develop faster growing and more pest-resistant varieties of trees, and specialists to develop new and unique uses for forest products. While these occupations require specialized skills and training, a basic understanding of forests and forestry is common to all of them.

This publication was designed to provide training in skills used by technicians and foresters throughout the world who plant, care for, and harvest trees. While this curriculum is by no means comprehensive, it will provide the student with the skills and, perhaps, the desire to begin a career in forestry.

Randy Kirk, Curriculum Specialist
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Randy Kirk, Curriculum Specialist
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Technical Education

USE OF THIS PUBLICATION

INSTRUCTIONAL UNITS

Forestry contains sixteen units. Each instructional unit includes some or all of the basic components of a unit of instruction: performance objectives, suggested activities, handouts, information sheets, supplements, transparency masters, activity sheets, assignment sheets, assignment sheet answers, job sheets, practical tests, written tests, and written test answers. Practical tests and written tests are included in the instructor edition only, and may be duplicated for classroom use or copies may be purchased in Oklahoma by calling 800-522-5810. Out-of-state instructors may order test packets by calling 800-654-4502.

All of the unit components focus on measurable and observable learning outcomes. Instructors are encouraged to supplement, personalize, localize, and motivate with these materials in order to develop a complete teaching/learning process.

Units of instruction are designed for use in more than one lesson or class period of instruction. Careful study of each unit of instruction by the instructor will help him or her determine the following:

- Amount of material that can be covered in a class period
- Skills that must be demonstrated
  - Supplies and equipment needed
  - Amount of class time needed for demonstrations
  - Amount of time needed for student practice
- Supplementary materials, including print and non-print media to be ordered
- Resource people to be contacted

Objective Sheets (White Pages)

Each unit of instruction is based on performance objectives. Performance objectives are stated in two forms: unit objectives, stating the subject matter to be covered in a unit of instruction, and specific objectives, stating the performance necessary to meet the unit objective.

The unit objective states the overall goal of the unit. It tells what the student should be able to do and what standard will be used to determine whether the student has achieved competency. Specific objectives outline the teaching sequence of the competencies required to meet the unit objective.

The objectives should be provided for students and their importance stressed throughout the teaching/learning process. By doing this, instructors will help answer any questions concerning performance requirements for each instructional unit. Instructors can also use the objectives to plan teaching strategies and instructional methods. Instructors should prepare for each unit by deciding how each objective can best be taught.

Instructors should feel free to modify, delete, or add objectives in order to meet the needs of the students and community. When objectives are added, the instructor should remember to supply the needed information, assignment sheets, job sheets, and criterion test items.

Suggested Activities (Pink Pages)—Instructor's Edition Only

The suggested activities component is to assist during the preparation stage of the teaching/learning process. The activities provide suggestions for delivery, application, and evaluation during the instructional process. Teaching suggestions are included for each objective. The instructor should read the suggested activities before teaching the units to allow time to obtain supplemental materials, prepare audiovisual materials, and contact outside resource persons. Duties of the instructor will vary according to the particular unit.

Listed are suggested resources including people and print and non-print media that may be used to teach the unit. Unit references used in the development of each unit are also provided. The instructor can use suggested resources and unit references to supplement his or her knowledge of the subject or to help students with particular interests or objectives in the area covered. Please note that suggested resources and references listed in this publication existed when this publication was written. CIMC assumes no responsibility for providing these materials and cannot ensure the availability of these materials as individual vendors, manufacturers, and publishers may discontinue these products at any time.

Teacher Supplements (Pink Pages)—Instructor's Edition Only

The teacher's supplements found in some units of this publication contain information that will aid the instructor in his presentation of the materials. In some cases, the instructor may want to distribute the information to the class. The development committee felt that although this information was useful, it would be up to the individual instructor to determine how it should be used.

Handouts (White Pages)—Instructor's Edition Only

Handouts provide "nice-to-know" information that is not testable. Handouts provide the instructor with additional information and activities. They may also include items for the gifted or remedial student. The instructor may decide whether to use handouts in teaching the unit.

Information Sheets (Green Pages)

The information sheets provide "must know" content that is essential for meeting the cognitive objectives. The information sheets serve as an excellent guide for presenting background knowledge necessary to develop the skills specified in the unit objective. They may also be used for coordination activities and advisory committee meetings.

Students should read the information sheets before the information is discussed in class. Space is provided in margins for students and instructors to add notes that supplement, localize, personalize, or provide motivation for each unit.

The information sheets may include notes, cautions, or warnings. These should be discussed carefully and thoroughly. Notes are short verbal additions to the information or procedural outline that provide nice-to-know and decision-making information. A note may tell the student what to look for or consider at a given step, or may explain when a step may not be applicable. Notes offer guidance that may help the student understand the process and accomplish it more efficiently. Warnings are advisories that alert the student to possible danger to himself or herself or others. Cautions are advisories that alert the student to possible danger to equipment or facilities.

Supplements (Green Pages)

Supplements are in the instructor and student material. Supplements include instructions that could be used for solving problems or reinforcing the enrichment of learning. The information presented in a supplement may consist of tables, charts, written information, forms, or other information students will need in order to complete one or more of the assignments or job sheets. While supplements are not tested over directly, they may be used to assist in meeting the performance objectives.

Transparency Masters (White Pages)

With transparency masters, the students may see as well as hear about the material being presented, thus reinforcing the learning process. Transparencies may present new information or they may reinforce information presented in the information sheets or assignment sheets.

Transparencies should be made and placed in the instructor's notebook, where they will be immediately available for use. Transparencies direct the class's attention to the topic of discussion. Transparencies should be left on the screen only when topics shown are being discussed.

Activity Sheets (Tan Pages)

The purpose of activity sheets is to provide activities which support several objectives. Activity sheets vary greatly in their number and design from unit to unit. Some activity sheets deal with the student's attitudes and beliefs. These may ask rather personal questions and are only intended for each student's personal use. Some activity sheets may require the student to monitor his or her own actions or other personal variables over a period of time. Answer sheets may or may not be included.

Assignment Sheets (Tan Pages)

Assignment sheets are written exercises that have students apply higher order thinking skills. The introduction to the assignment sheet explains how the assignment relates to the subject area and unit objective and may provide instructional information or refer students to another component for such information.

Often, assignment sheets will contain case studies, story problems, or other situations in which the student must analyze the circumstances and determine correct responses. Students may be given assignment sheets as classwork or homework.

Assignment Sheet Answers (Pink Pages)—**Instructor's Edition Only**

This component is designed to assist the instructor in evaluating student performance on assignment sheets.

Job Sheets (Blue Pages)

Job sheets provide a list of equipment, tools, and materials needed to complete a manipulative or psychomotor skill. They describe a step-by-step procedure to complete each task or job. Diagrams, photographs, and illustrations assist students in achieving the skill.

The instructor should demonstrate the procedures outlined in each job sheet. Furthermore, the instructor needs to localize the procedure according to the equipment and supplies available in the local situation. Job sheets also show potential employers what skills the student has been exposed to and the performances one might reasonably expect from a student who has had this vocational instruction.

Practical Tests (Yellow Pages)—Instructor's Edition Only

The practical tests assist the instructor in evaluating the psychomotor activities (Job Sheets). The practical tests provide instructors with a valid mechanism for determining a student's level of ability to perform the procedure stated on the job sheet and provide the instructor with a means of evaluating the student's final product.

Written Tests (Yellow Pages)—Instructor's Edition Only

This component provides criterion-referenced evaluation of every objective listed in the unit of instruction. All performance objectives, including those in the information sheets, assignment sheets, and job sheets must be evaluated. If objectives have been added, deleted, or modified, appropriate changes should be made on the test.

The tests may be written or oral. It is recommended that the tests be divided into shorter tests covering three or four objectives at a time and given soon after those objectives have been covered.

The acceptable response on a written test, eighty-five (85) percent in most units, may be raised or lowered to fit the topic or student ability level. The percentage applies to the overall score, not to each individual question. The final unit grade should be obtained by combining written test and assignment sheet scores, and by considering how well the student demonstrated the desired skills.

Written Test Answers (Pink Pages)—Instructor's Edition Only

This component is designed to assist the instructor in evaluating student performance on written tests.

PAGE NUMBERING

Each publication for the CIMC is assigned a specific abbreviation or will be recognized by the book title. *Forestry* will be referred to by title. Each unit is identified by the unit number in Roman numerals. Each unit in the publication begins with page 1. The page number for an objective sheet in *Forestry* looks like the following:

OBJECTIVE SHEET - Forestry
I - 1

METHODS OF DISSEMINATING MATERIAL

Each student should be provided with student materials. Materials may be purchased for less than an instructor can reproduce them, especially when the instructor's time is considered. Student materials contain everything but the suggested activities, teacher supplements, handouts, assignment sheet answers, tests, and test answers. Written test packets may be purchased from the Curriculum and Instructional Materials Center. The student should be allowed to take his or her materials home at the end of the year.

TEACHING METHODS

It is a challenge to keep students motivated. Instructors can supplement the objectives by providing the "why," personal experiences, and current information. Preparation for each unit should be determined by how each objective can best be taught. Students should become involved in preparing and planning for each unit.

COMPETENCY PROFILES

A competency profile is available for each CIMC publication. Competency profiles document student performance. The profile contains a list of the specific competencies that a student should achieve before leaving the training program. Profiles should be distributed to students as needed.

CORRECTIONS AND SUGGESTIONS

The Curriculum and Instructional Materials Center (CIMC) wants to provide vocational instructors and students with materials that are accurate and effective. Although the CIMC strives to maintain the highest standards of development and production, oversights occasionally do occur. If you find any errors in this or other CIMC publications, or have suggestions for improving their usefulness in vocational programs, please notify the CIMC staff. One easy way of pointing out errors is to make a photocopy of the affected page and to indicate the correction on the copy. Mail this information to the CIMC, where it will be used to correct the publication before the materials are reprinted.

To ensure that the material is updated on a timely basis, notify the CIMC of necessary corrections as soon as possible after discovering the error. Do not assume that someone else will notice the error and inform the CIMC; other users may be making the same assumption. Please send corrections and recommendations for improving this publication to the following address:

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BASIC SKILLS IN CIMC MATERIALS

Preparing students to enter successfully into today's world of work offers vocational education a substantial challenge. The contemporary workplace is characterized by constant and rapid technological change and by increasing job complexity and skill intensity. Due to rapid technological advancement, the half-life of work skills is now reduced to a bare three to five years. Out of this new workplace environment has arisen a growing national awareness of the critical importance of an American workforce armed with the skills necessary to survive in a competitive economy.

One result of this national awareness has been the emergence of a renewed emphasis on basic academic skills in all areas of education. Pressure to increase academic skill development is being placed on education by both legislative action and industry mandate. The new Carl D. Perkins Vocational and Applied Technology Education Act of 1990 sets stringent basic skill requirements for vocational education. State legislatures are increasingly requiring basic skills accountability by teachers and school administrators. Graduation exams, minimum competency requirements, and expected learner outcomes are being implemented with increasing frequency. In addition, business and industry are delivering the message clearly to educators that vocational competence now requires increased strength in the basic skills.

The issue of the basic skills currently required in the work place was very successfully addressed in a recent national three-year study conducted jointly by the American Society of Training and Development (ASTD) and the U.S. Department of Labor (DOL). The findings of this study were published in 1990 in the book, *Workplace Basics: The Essential Skills Employers Want.*

The ASTD/DOL research indicates clearly that American employers have discovered that their workforces need a variety of skills that include, but are not limited to, the classic academic trio of reading, writing, and computation. Employers now are also looking for competence in areas such as "learning to learn," problem solving and critical thinking, interpersonal and teamwork skills, oral communication and listening techniques, and the social and personal management skills that demonstrate a capacity for independence and responsibility in on-the-job performance.

It is clear that the requirements of today's business and industry have expanded and redefined "workplace basics." It is in line with this redefinition, and with the competency requirements of current education legislation, that the Oklahoma Department of Vocational and Technical Education has chosen to address "basic skills" in the instructional materials produced by its Curriculum and Instructional Materials Center.

It is not a new development for CIMC materials to contain information and activities which develop basic skills competencies in students undertaking vocational programs. What is new is the specific marking, or flagging, of items in our instructional materials that address basic skills.

To assist teachers and students in identifying activities which promote basic skills development, CIMC has implemented a marking system which uses simple graphic symbols, or icons. These icons are located in the left margins of Assignment Sheets, Activity Sheets, and Job Sheets. The following is an explanation of the icons and the kinds of basic skill activities they indicate.

1. **READING SKILLS:** Skills involving use of print resource material for obtaining and applying information.

Current vocational education literature indicates that functional literacy as a workplace basic needs to be defined in terms of reading competencies actually required for job performance. The activities identified with this icon as addressing reading skills in CIMC materials deal specifically with developing reading skills in an applied, job-related context. These range from general information-gathering activities to tasks requiring use of specific technical reference materials. Many contain a "learning to learn" aspect, which promotes engaging actively and purposefully in vocationally relevant inquiry.

2. **WRITING SKILLS:** Skills involving written communication of processes, information, or ideas.

Tasks identified with this icon promote development of skills in written communications. As with reading skills, the writing skills emphasized in CIMC materials have a vocational context. They include filling out forms, keeping work activity records, writing simple memos and letters, generating more complex reports and articles, and written expression of ideas and concepts related to vocational performance or exploration.

3. **MATHEMATICS SKILLS:** Skills involving computation, calculation, and interpretation of numerical data.

This icon identifies activities which develop vocationally-related skills in computation, measurement and estimation, selection and application of appropriate mathematical processes, and collecting, displaying, or interpreting data.

4. **SCIENCE SKILLS:** Skills involving mastery and application of scientific information or theory.

This icon marks activities which are related to the development of skills in either the physical or biological sciences. These skills stress occupationally-related applications of science and technology.

5. **ORAL COMMUNICATION SKILLS:** Skills involving speaking and listening.

Activities marked with this icon promote development of effective speaking and listening. They include practice in such areas as speaking techniques, word choice, non-verbal messages, use of communication media, and using active listening techniques. Many of these activities promote "learning to learn" skills in verbal inquiry.

6. **INTERPERSONAL OR RELATING SKILLS:** Skills involving working and getting along with others.

Activities which deal directly with skills in relating to others are marked with this icon. This includes areas such as multi-cultural awareness, group processes and dynamics, negotiation, dealing with conflict, cooperation and teamwork, values and attitudes, and leadership and motivation.

7. **CREATIVE THINKING AND PROBLEM SOLVING SKILLS:** Skills involving comprehending, applying, analyzing, and developing complex ideas and situations.

This icon identifies activities which stress development of higher-order thought processes such as problem identification and analysis, lateral thinking, evaluating alternatives, developing solutions, examining assumptions, and evaluating outcomes.

8. **EMPLOYABILITY SKILLS:** Skills involving choosing, obtaining, and succeeding in a career.

Activities marked with this icon relate to competencies required to obtain employment and develop a career. These competencies include specific occupational tasks. They also include items such as career analysis and selection, job searching, completing applications and resumes, interviewing, and business etiquette, and personal management skills required for job-keeping and maturing in one's work. Examples of the later category include personal presentation, self-discipline, work accuracy, reliability, discretion, punctuality, handling stress, judgement, confidence, etc.

9. **SOCIAL STUDIES SKILLS:** Skills involving investigation and application of social concepts.

This icon marks activities which stress competencies in fields relating to human society and its distribution and relationships. This includes areas such as history, geography, government and politics, economics, psychology, sociology, demographics, current events, cross-cultural studies, consumer issues, environmental issues, and ethical concerns in science and technology.

Some activities in CIMC materials develop skills in more than one of the nine basic skill areas. In cases where the relative strengths of the skill elements are clearly discernable, the identification icon used is the one judged to be the primary, or strongest, element in the activity. For some activities, more than one icon is used, indicating equal strength of basic skills components in the activity.

The use of graphic icons to identify basic skills in CIMC instructional materials is the first in a series of steps designed to foster basic skills development in vocational students and accountability for vocational teachers. The Oklahoma Department of Vocational and Technical Education has developed a staged implementation strategy for integrating basic skills into CIMC materials. Additional basic skill elements in future CIMC publications will reflect the advancement of this staged implementation.

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OBJECTIVE SHEET

EXPLORE THE WORLD OF FORESTRY

I

INTRODUCTION

Forestry is an art and a science. It is an incredibly broad field and its purpose is to manage the forests of our nation and the world. Trees are a crop, just as wheat and corn are crops, but a single planting takes 15-50 years before it is ready for harvest. We couldn't live without trees because they provide oxygen, prevent erosion, add moisture to the atmosphere, protect the land from wind and water damage, and clean pollutants from the air. They provide food and shelter for us and for wildlife. Trees also provide products such as wood, wood fibers, chemicals and medicines, materials we need for almost every aspect of our lives.

Seventy percent of the forest area which was growing when Columbus arrived is still growing. Yet our forested land is barely keeping up with our demands for wood and wood products. If we had good forest management throughout the United States, our forest soils could produce twice as much timber, yet we import wood from Canada and other countries.

Our forests are a renewable resource—if they are properly managed, they will continue to produce trees forever. It's the job of forestry to see that they do.

PREREQUISITES

None

UNIT OBJECTIVE

After completing this unit, the student should have a basic understanding of the importance of trees and forests, the history and current status of United States forests and forestry, and know the resources involved in multiple-use forest management. The student will demonstrate these competencies by completing the assignment sheets and written test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with exploring the world of forestry to their correct definitions.
2. Define forest and forestry.
3. List the elements of a forest community.
4. Select from a list true statements about the importance of trees and forests.

5. Complete statements about the amount of forested land worldwide and in the United States.

6. Choose the best word or phrase to complete statements about the history of forestry in the United States.

7. Choose the best word or phrase to complete statements about the present forest situation.

8. Choose the best word or phrase to complete statements about the importance of forests in the South.

9. Distinguish between preservation and conservation.

10. List resources considered in multiple-use forest management.

11. Determine local forest and forestry activities. (Assignment Sheet 1)

12. Observe forest conditions. (Assignment Sheet 2)

SUGGESTED ACTIVITIES

EXPLORE THE WORLD OF FORESTRY I

PREPARATION

- Obtain materials to supplement unit.

  NOTE: See Suggested Resources.

- Review instructional outline for this unit. Modify time frames to suit class needs and plan activities for each class period.

- Study specific objectives to determine those you will cover in your presentation. Decide also which objectives should be taught to which students.

- Determine scope and sequence of objectives that you add. Design and develop support materials, including evaluation techniques, for additional objectives.

- Determine how you will schedule time for students to demonstrate competence in the required procedures.

  NOTE: Assignment Sheet 1 requires about one week of research. Assignment Sheet 2 should be assigned over a weekend.

- Invite guest speakers such as a forester, consultant, soil conservation agent, timber producer or private forest owner to discuss forests, their work and their feelings about the forest.

  NOTE: Supply speakers with specific objectives and other appropriate sections of the unit.

- Arrange transportation for a field trip to a forested area.

- Prepare classroom.

  - Put up posters, charts, etc. dealing with the world of forestry.

  - Have available articles, brochures, and other items dealing with the world of forestry.

DELIVERY

Objective 1

- Discuss your own experience with forests and forestry.
- Discuss the importance of forestry activities in your community, particularly in employment opportunities.
- Discuss the economic contribution of forestry-related activities in your area.
- Review terms with students, using their own experiences and definitions as a starting point.
- Have students begin Assignment Sheet 1.

Objectives 2 through 5

- Define forest and forestry.
- Allow students to list what they think of as the elements of a forest community and use Objective 3 in the Information Sheet to discuss the various elements.
- Show slide/tape programs *The Forests We Share* and *Birds, Bees, and Trees.*
- Discuss with students the importance of trees and forests.
- Use the Information Sheet to learn the amount of forested land worldwide and in the United States; use measures of local distances, townships and other areas to create a direct understanding of this amount of land.
- Have students complete Activity Sheet 1 to support Objective 5.
- Use Activity Sheet 2 to promote students thinking about forests and forestry. Ask students for their impressions of forests. Ask for familiar stories and fairy tales that formed their first impressions of forests. Discuss how realistic those impressions were compared to their present knowledge.

  NOTE: This same activity will be repeated at the end of the course so students can have an objective measure of their progress.

Objective 6

- Teach students about the history of forestry in the United States.

- Show the video *Forests U.S.A.*
- Draw examples of family history from the students and discuss how history—where people settled, where they came from, and the environmental conditions they grew up in--can affect who the students and their parents are today; and extend the examples to the history of forestry.
- Stress the importance of history in getting an overview of a field of study such as forestry.
- Discuss how forestry has come to be considered as both science and art.

Objectives 7 and 8

- Discuss with students the present forest situation.
- Discuss the importance of forests in the South.
- Refer students to Supplement 1.
- Tailor the information on trees and forest conditions to your own region.

Objectives 9 and 10

- Discuss with students forest use and public attitudes toward forest use.
- Have a forester come to the class to discuss multiple-use and special interest groups.
- Encourage students to have a small group discussion or to give reports on various aspects of forest use, conservation, preservation, protecting endangered species, etc.
- Let students work together to research current issues in forestry and national park interests.

APPLICATION

Objective 11

- Use Assignment Sheet 1 to help students identify resource people and forestry-related businesses and activities in your area. The information gathered in this assignment sheet can be useful for other activities in the course.

Objective 12

- Use Assignment Sheet 2 to introduce students to the actual world of the forest through direct observation.
- Give students a weekend to complete the assignment on their own time.
- Encourage students to take the assignment seriously and to notice everything they can about the forest while they are there.

EVALUATION

Written test

- Explain to students that they will be asked to demonstrate on the written test actions listed in the specific objectives.
- Give written test.

  NOTE: The written test may be given in sections if desired.
- Evaluate students on assignment sheet activities if not previously done.
- Reteach and retest if necessary.
- Complete appropriate section of competency profiles.
- Review individual and group performance in order to evaluate teaching methods. Adjust scope, sequence, or instructional approaches for additional lessons as required.

SUGGESTED RESOURCES

Audiovisual Materials

- *The Forests We Share*, 100 slides/cassette, 10:30 min. Describes the uses of forests, from wood production to recreation. Discusses the variety of wildlife that make their homes in the forest, and explains how some people make their living from the forests. Available on a free-loan basis from Oklahoma Soil Conservation Service Office, USDA, Agricultural Center Office Building, Stillwater, OK 74074, (405) 624-4360. Teachers outside of Oklahoma should contact the local Soil Conservation Service.

- *Birds, Bees & Trees*, 74 slides/cassette, 6:35 min, Southern Forest Institute. Describes forest ecosystems and focuses on the interrelationships of trees to other trees, insects, wildlife, and man. Available on a free-loan basis from the Forestry Extension Program, Oklahoma State University, 242 Agricultural Hall, Stillwater, OK 74078, (405) 744-5444.

- *Forests U.S.A.*, 10:45, VHS, Color, 1985, U.S. Forest Service. Award-winning video depicts the role of the Forest Service in the economic and cultural development of the country in the last 200 years.

  NOTE: The above videotape is available to Oklahoma teachers on a free-loan basis from the Resource Center, Oklahoma Department of Vocational and Technical Education, ATTN: Instructional Media Specialist, 1500 West Seventh Avenue, Stillwater, OK 74074-4364. Out of state teachers may order from either the USDA Forest Service, Southern Region, 1720 Peachtree, N.W., Atlanta, GA 30367; or Forest Service—USDA, P.O. Box 96090, Washington, D.C. 20090-6090

Publications

- *Project Learning Tree*, American Forest Council, 1250 Connecticut Avenue NW, Washington, D.C. 20036, 1986. The activity book can be obtained only by attending *Project Learning Tree Teacher Workshops*. Contact your County Extension Agent or State Forestry Division for information.

- *Sawmill: The Story of Cutting the Last Great Virgin Forest East of the Rockies*, Kenneth L. Smith, University of Arkansas Press, Fayetteville, Arkansas, 1986. Explores sawmills, lumbering companies and company towns in the Ouachita Mountains in Arkansas and Oklahoma. Students can check the local library or request this book on interlibrary loan.

Speakers

Oklahoma Natural Resources Speakers Bureau sponsored through Oklahoma State University, Division of Agriculture, Oklahoma Cooperative Extension Service - Forestry, Oklahoma Conservation Commission and the Oklahoma Forestry Association. Lists speakers on a variety of forestry-related topics. Speakers operate on a time-available basis. Request a listing of speakers, programs, slide presentations and videotapes from your local extension office or from:

Dr. Steve Anderson
Forestry Dept.
Oklahoma State University
239 Agricultural Hall
Stillwater, OK 74078
(405) 744-9431

Dave Marcouiller
Forestry Dept.
Oklahoma State University
242 Agricultural Hall
Stillwater, OK 74078
(405) 744-5444

Teachers from outside of Oklahoma should contact the Forestry Extension Office in their state.

Other media

- Address for summer job applications for the Youth Conservation Corps:

  Ouachita National Forest
  P.O. Box 1270
  Hot Springs, AR 71902
  Attn: Personnel Officer

- *Oklahoma Forest Industries Buyer's Guide*

  Available from:

  Oklahoma Department of Agriculture
  Market Development or Forestry Divisions
  2800 North Lincoln Boulevard
  Oklahoma City, OK 73105-4298
  (405) 521-3864, Ext. 315 or 318

UNIT REFERENCES

- Anderson, David A. and I. I. Holland, *Forests and Forestry*, The Interstate Printers & Publishers, Inc., Danville, Illinois, 1982.
- Collins, B. McManus, and Fred M. White, *Elementary Forestry*, Reston Publishing Company, Reston, Virginia, 1981.

- *Forestry in the South: Watching Over America's Woodbasket*, Southern Forest Products Association, New Orleans, Louisiana, 1978, rev. 1984.
- "The Global View," *American Tree Farmer*, January-February, 1988, p. 13.
- *Harvesting Forestry Products*, Texas A & M University, College Station, Texas, 1976.
- Stoddard, Charles H. and Glenn M. Stoddard, *Essentials of Forestry Practice*, 4th ed., John Wiley & Sons, New York, 1987.
- Waddell, Karen L., Daniel D. Oswald and Douglas S. Powell, *Forest Statistics of The United States 1987*, United States Department of Agriculture, Forest Service, 1987.

OBJECTIVE 1

Match terms associated with exploring the world of forestry to their correct definitions.

- **Carnivores**—Animals that eat the flesh of other animals

  EXAMPLES: Snakes, coyotes, wolves, hawks, eagles, and some bears

- **Commercial**—Done primarily for sale or profit

  NOTE: "Commerce" means the buying and selling of goods, especially on a large scale.

- **Ecosystem**—The interaction of all living things and their environment in the same area

- **Hardwood**—Broadleaved trees

  NOTE: All broadleaved trees are considered hardwoods regardless of the density or strength of the wood. They are contrasted with the needle-leaved trees, considered to be softwoods. Most broadleaved trees lose their leaves in the winter, while needle-leaved trees stay green.

  EXAMPLES: Oak, maple, sweetgum, cherry, pecan, walnut, and ash

- **Herbivores**—Animals that eat mostly grass and other green plants

  EXAMPLES: Mice, rabbits, deer, cattle

- **Microorganisms**—Fungi, viruses, and bacteria that contribute to the life cycle of all organisms

- **Nutrients**—Minerals that promote growth and development

  EXAMPLES: Nitrogen, potassium, phosphorous, calcium, magnesium

- **Resources**—Something owned by a state, country, organization or individual that can be used to its advantage

  EXAMPLES: Forests, water, mineral ores such as gold and silver, wildlife, and natural tourist attractions

- **Sociology**—The study of human society

- **Softwood**—Needle-leaved trees that retain their leaves in the winter

  NOTE: The bald cypress is an exception. It is a deciduous conifer that loses its needles in the winter.

  EXAMPLES: Pines, cedars, firs

- **Sustained yield**—Continual, permanent production from commercial timberland

- **Urban**—Having to do with cities

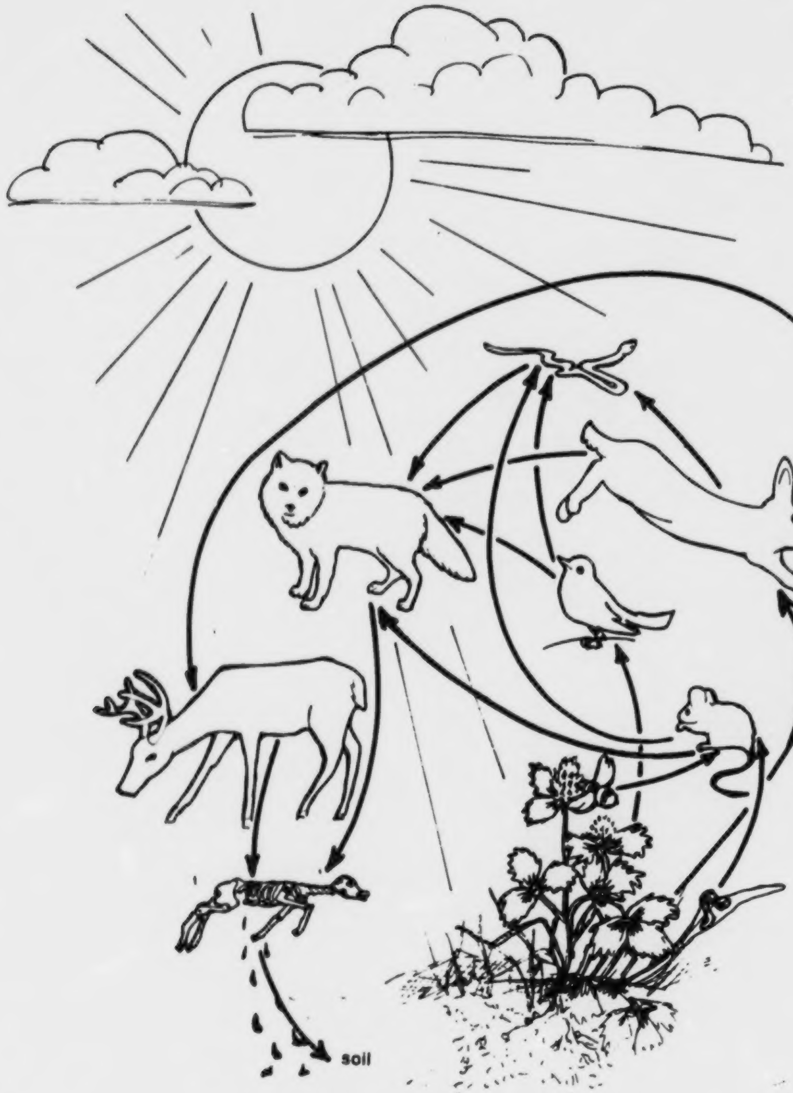
- **Watershed**—An area in which all the draining or runoff flows into a given stream

OBJECTIVE 2

Define forest and forestry.

- **Forest**—A living, self-renewing ecosystem involving a complex association of plants and animals in which each individual plays some part in the life of the community.

  NOTE: The forest is constantly changing and going through the life cycles of new trees growing and old or diseased trees dying. The trees and plants make their own food with carbon dioxide and oxygen from the air and nutrients from the soil and water. Herbivores browse on the vegetation and are eaten, in turn, by carnivores. When plants or animals die microorganisms decompose their remains, turning them into soil. The soil, rich with the nutrients from the decayed materials, provides food for the plant life.



All animal life depends on plants for food.

Adapted with permission of the Boy Scouts of America.

- **Forestry**—Work concerned with the multiple use of forest lands and resources, including their management and protection.

  NOTE: Forestry is an art and a science. It strives to produce, on a continuous basis, the highest quality and the maximum quantity of forest products and services. *Continuous basis means a management system that scientifically protects and renews the forest resources.*

OBJECTIVE 3

List the elements of a forest community.

A forest is made up of many different elements which interact to form the forest community. The forest community is a complex and interdependent community.

NOTE: Before any kind of major project can be started in a forest or other natural resource area, an Environmental Impact Statement (EIS) must be written. The EIS is a description of the projected actions and their effects on all elements of the forest community. For example, the Forest Service is putting together a management plan for the Ouachita National Forest in Oklahoma and Arkansas. The EIS is a description of the plan outlining what their management is going to do to the environment. The report will include possible alternative management systems and what effects these systems will have on the various renewable resources. The EIS takes a lot of time, money, and personnel to complete; but as you are aware, environmental protection grows increasingly important as pollution and other effects of previous poor management systems become obvious.

The forest consists of eight elements:

- Trees
- Plants
- Shrubs
- Soil
- Water
- Animal life

  NOTE: Includes bacteria, fungus, insects, rodents, birds, mammals, fish
- Human life
- Fire

  NOTE: Fires can be a benefit to the forest. Brush, grass, limbs, and leaves build up on the forest floor. A low-temperature, controlled fire, called a prescribed burn, can keep the debris cleared out. If it is allowed to build up, it provides a great amount of fuel for an accidental fire that can cause serious damage to the forest.

OBJECTIVE 4

Select from a list true statements about the importance of trees and forests.

- **Provide wood products**—It's estimated that 5,000 different products are made from wood. Every year, each person in the United States uses the equivalent of 1 acre of trees or one 100 foot tree that took 50 years to grow. As of 1989, the per capita use of paper in the United States was 613 pounds per year. In China, it was only 13 pounds per year. The United States' demand for wood products may double by the year 2030.

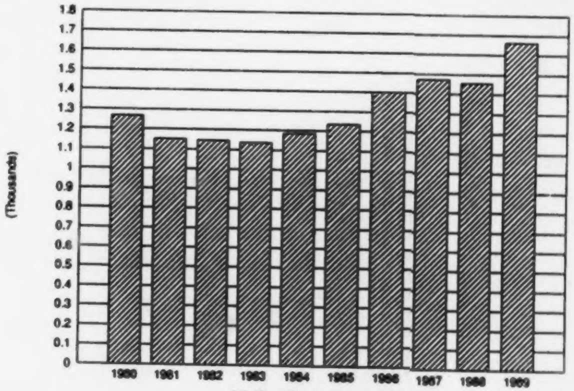
  Nearly half of the world's population depends on wood as the major source of heating and cooking fuel. Two-thirds of all wood cut is used for fuel.

  Paper production is a major use of wood products, but most wood used for paper comes from thinnings or improvement cuts and not from mature trees.

  EXAMPLES: Paper, packaging, lumber, chemicals, paints, plastics, fuel, fabrics

- **Provide employment**—More than 1.2 million men and women in the United States earn their livings directly from forestry activities. The forest industry ranks among the top ten employers in 48 states, creating an annual payroll of more than $26 billion.

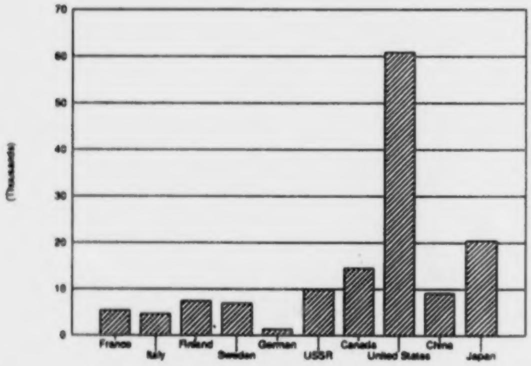
- **Influence United States and world economics**—United States paper sales generate more than $100 billion per year. The United States exported 11.4 million tons of paper products in 1988, valued at $6.8 billion. Study the charts below to determine the major producers and markets.



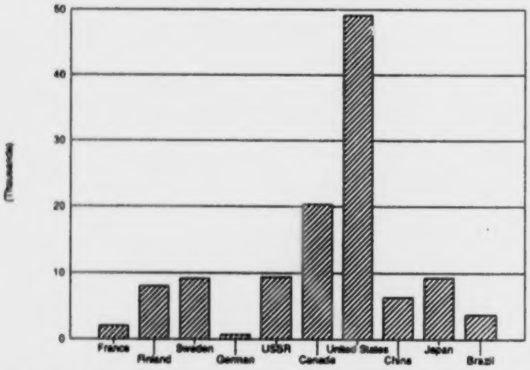
U.S. Housing Starts

Source: Wood Supply and Demand Information Service, 1990.

World's Top Ten Producing Countries



Paper and Board



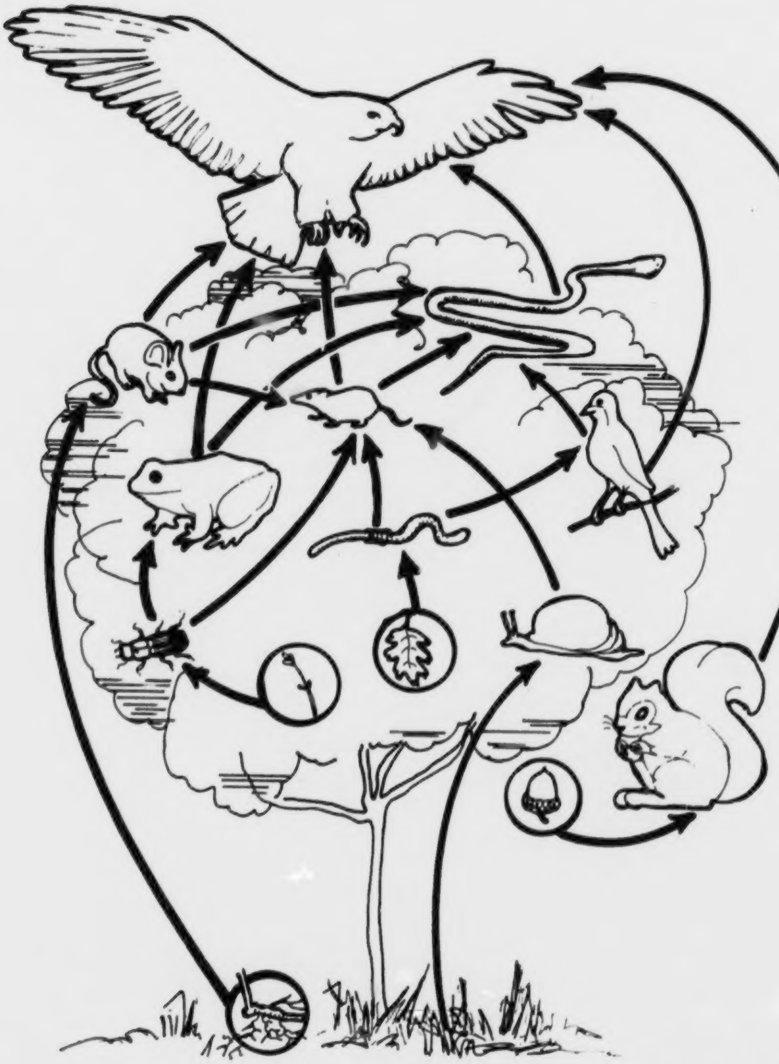
Source: *Pulp and Paper International Factbook*, 1990.

- **Influence the climate**—Large forested areas, such as the tropical rain forests of Brazil, generate huge volumes of clouds that affect the way heat is distributed around the globe. Smaller, local forests can create temperature differences (cooler in summer, warmer in winter), windbreaks, and moisture storage, especially in urban areas.

  NOTE: The loss of tropical rain forests to agriculture and development could have major consequences on the "Greenhouse Effect," increasing the overall temperature of the earth as the moisture and cooling effect of the trees are lost.

- **Control runoff**—Fallen leaves and branches on the forest floor absorb water and reduce surface runoff, helping to regulate the flow of water in streams and rivers. Good forest management can control water flow and aid in flood prevention.

- **Influence the food chain**—Forests provide a habitat for fish and wildlife. The health and balance in a forest affects the ecosystem and the food chain.



Food Chain

Adapted with permission of the Boy Scouts of America.

- **Remove pollutants from the air, soil, and water**—As part of the normal air and water exchange, trees take in toxic gases and use them to create food and energy. Leaves can trap other particles in the air. Rain, wind, or gravity will carry the particles to the ground.
- **Prevent soil and wind erosion**—Water washes over materials on the forest floor more slowly than on bare soil, so that soil stays in place and does not pollute streams. Trees protect open plains areas from the effects of wind. Wind can strip off topsoil and can dry good soil, causing it to blow away. Trees also protect buildings, livestock, and crops from wind damage.
- **Provide recreational opportunities**—Forests provide recreational opportunities such as hunting, fishing, sports, camping, and hiking.
- **Provide aesthetic benefits**—Beauty, serenity, the feeling of space, the closeness of wildlife in natural settings, and the overall atmosphere of a forest help renew the human spirit.

OBJECTIVE 5

Complete statements about the amount of forested land worldwide and in the United States. (Activity Sheet 1)

NOTE: Write out these numbers to compare the acreages.

- Worldwide, excluding Antarctica, there are **3.21 trillion acres** of total land mass and **89.9 billion acres** of it is forested.
- The United States has about **737 million acres** of forested land.
- Of this land, almost 2/3 or **483 million acres** is commercial timberland.

OBJECTIVE 6

Choose the best word or phrase to complete statements about the history of forestry in the United States.

1600-1800 Forest utilization in the New World

When the first European settlers came to North America, they found vast, dense forests covering 820 million acres. The trees were some of the largest in the world, and there were almost 10 times as many species as they had known in Europe.

The thick forests and underbrush made travel difficult and provided cover for hostile Indians. The settlers cleared the land as quickly as they could to provide security, housing, heating and cooking fuel, and cropland.

Despite the apparently infinite supply of wood, the early immigrants attempted forest conservation. In the 1620s Plymouth colony forbade the cutting of trees in the colony without permission. In the 1680s William Penn, the founder of Pennsylvania, required that for every 5 acres of forest land cut, 1 acre was to be left standing.

The first sawmill was built in Maine in 1623. Naval stores, not sawed timber, was the major business of the forest industry. Naval stores are tar, pitch, and turpentine made from pine sap and used to seal, paint, and repair wooden ships.

The science and practice of forestry began in Europe but didn't come to North America until the end of the 1700s.

For almost 200 years (1620-1800) settlement and deforestation were limited to the East coast area from Maine to the Florida border and fuel was the main use of wood.

1800-1900 The United States recognizes the need for conservation.

After 1800 and the end of the Revolutionary War (1775-1783), more Europeans arrived and pushed back the American forest for agriculture. Fuel demands decreased as coal and petroleum came into use, but sawtimber, tools, and furniture manufacturing replaced fuel as important uses of wood.

The speed and degree of deforestation created public alarm and pressure to protect this vital national resource.

Between 1799 and 1831, Congress passed the first forest protection laws to save live oaks and redcedar for shipbuilding.

In 1850 railroads opened up the country for settlement. The federal government granted the railroads 200 million acres of land, through some of the best timberland available. Most of it was sold as sawtimber.

In 1867, Michigan and Wisconsin formed state committees on forest protection. Minnesota, four years later, created a law that paid a bounty for planting seedlings and Nebraska initiated Arbor Day, celebrated with the planting of trees.

The federal government followed in the 1870s with the Timber Culture Act granting 160 acres of federal land to any person who would plant 40 acres of the area with trees and maintain them for ten years. The law was repealed because recipients failed to keep their commitments.

By 1870, 29,000 sawmills were in full production.

The turning point was the founding of the American Forestry Association in 1875 to educate the public about the need for conservation.

Finally, in 1891, Congress started the National Forest Reserves, which later became the National Forests, under the Department of the Interior.

In 1897 Congress passed the Forest Service Organic Act, which meant that national forests would be managed according to forestry principles.

1900-1940 The action years

At the turn of the century there were 90,000 family farms established annually. Lumber was in great demand and timber supplies became low. Once a national forest program had been established, agencies, organizations, and legislation to regulate the program expanded rapidly.

The Forest Service became part of the United States Department of Agriculture (USDA) in 1905, with Gifford Pinchot named as the first Chief Forester.

In 1916 The National Park Service was organized in the Department of the Interior.

The 1920s saw legislation enabling the federal government to purchase forest lands to harvest, manage, and plant timber and to protect streams and rivers. The first sustained-yield management program was started by Goodman Lumber Company in Wisconsin.

In 1924 the Clarke-McNary Act authorized the Secretary of Agriculture to cooperate with states on protecting the timbered and forest-producing lands from fire, studying the effects of tax laws on conservation and timber production, researching and promoting reforestation after a fire, growing and distributing seedlings, and educating farmers about woodlot use and management.

In the 1930s, as part of the "New Deal" program, President Franklin D. Roosevelt urged Congress to form the Civilian Conservation Corps (CCC) to relieve unemployment during the Great Depression that followed the 1929 stock market crash. The CCC hired more than 2 million young men to plant trees, restore watersheds, work on erosion control and other jobs to improve our natural resources.

The Forest Service developed "A National Plan for American Forestry" calling for (1) a large extension of public ownership of forest lands, (2) more intensive management on all forest lands, and (3) public control over private forest cutting practices.

The Tennessee Valley Authority provided for an active forestry and watershed management program.

The Soil Erosion Service, now the Soil Conservation Service, was founded to protect land and soil resources and help farmers improve management practices.

The Oregon and California Act of 1937 was the first national sustained-yield forestry law.

For the first 50 years of forestry legislation, most federal, state, and private funding for forestry went to fire protection.

1940-1990 Improving forest and resource management

During the period of 1941-1945, World War II created heavy demands for wood products. The post-war years, 1945-47 saw an intensive appraisal of the United States forest situation, indicating a marked deterioration in quality as well as quantity of timber during the war. The study prompted major changes toward better forest management practices, including educational programs. The Forest Pest Control Act passed in 1947, and the number of private consulting foresters grew significantly.

The decade of the 1950s was not as progressive as other decades. From 1952-57, the Forest Service made another major assessment of the forest situation. Congress made Smokey the Bear the legally-protected symbol of forest-fire prevention education. In 1958, the Bureau of Outdoor Recreation was established, later named the Heritage Conservation and Recreation Service.

Of the many changes that have occurred in the last 50 years, one of the most important was the Multiple Use Act and the Sustained Yield Act of 1960. It authorized the Forest Service to manage National Forests for a variety of uses, including timber, wildlife, grazing, watershed, minerals, wilderness, and recreation. The profession of forestry expanded enormously to take in all these fields of management.

Emphasis in the 1960s was on outdoor recreation and wildlife. Legislation included the Wilderness Act of 1964 that defined a wilderness area as an "area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. . . . has outstanding opportunity for solitude or a primitive and unconfined type of recreation . . . has at least 5,000 acres of land . . . and may contain ecological, geological, or other features of scientific, educational, scenic, or historical value."

Other important bills in the 1960s covered forest roads and trails. The Wild and Scenic Rivers Act provides funds to study and protect rivers with outstanding geologic, scenic and cultural attributes.

Conservation measures marked the achievements of the 1970s.

The 1970 National Environmental Policy Act (NEPA) declared that harmony between people and the environment is to be a national policy and established a Council of Environmental Quality. All federal agencies are required to prepare reports on the environmental impact of planned programs or actions and to suggest alternative actions.

That same year Woodsy Owl became the symbol for antipollution education and the Youth Conservation Corps was formed under the Nixon Administration to hire and train young people to develop, preserve, and maintain the lands and waters of the United States.

NOTE: The Youth Conservation Corps Act is still in effect as of January 1991 for people 16-18 years old. If you are eligible and interested or know someone who is interested in working with the YCC, ask your instructor how to request an application form.

The Endangered Species Act, Forest Land Rangeland Renewable Resources Planning Act (RPA) and a number of other policies promoted major improvements in management and use. The RPA authorizes the Secretary of Agriculture (Forest Service) to assess the nation's renewable resources every ten years and prepare a 40-year plan, to be approved by Congress and updated every five years.

The 1978 Cooperative Forestry Assistance Act repealed and replaced several earlier acts, including the Clarke-McNary Act. It enabled the Forest Service to work with State Foresters on non-federal lands to advance forest management, encourage timber production, prevent insect and disease damage, prevent and control rural forest fires, effectively use wood and wood residues, improve fish and wildlife habitat, and plan and conduct urban forestry programs.

After the broad, sweeping legislation of the 1960s and 70s, management and land use reform in the 1980s, under President Ronald Reagan, slowed considerably, focusing on conservation, recreation and taxes. There were two significant areas of legislation.

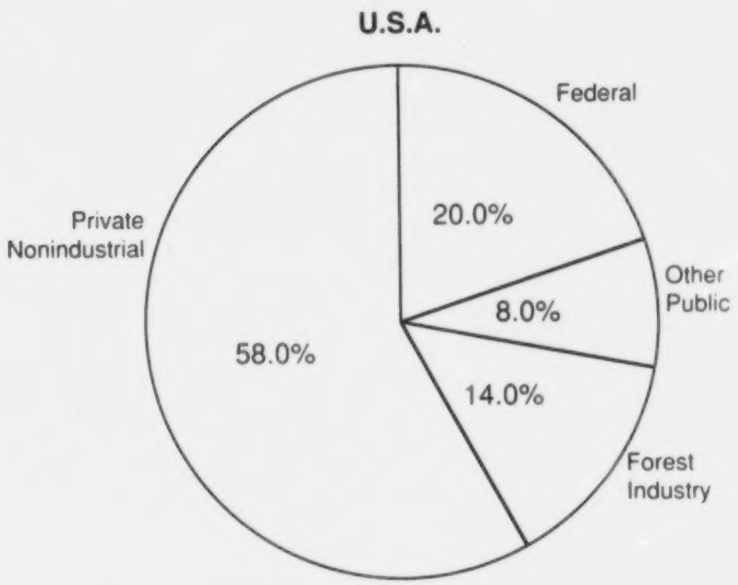
The 1980 Alaska National Interest Lands Conservation Act was one of the most sweeping conservation laws in history. It placed over 100 million acres of land into National Parks, Wilderness Areas, and Wildlife Refuges, and allotted the remaining lands to native Alaskans, private individuals, and the state.

The Conservation Reserve Program of 1985 authorizes the Secretary of Agriculture to contract with farm landowners to plant trees or permanent vegetative cover to protect land from erosion. Contracts are for 10 years and landowners receive annual payments for participating in the program.

One of the effects of improved management has been to create a more even distribution of funds for a range of conservation issues.

At present approximately 40% of United States forests are under management of some kind.

OBJECTIVE 7 **Choose the best word or phrase to complete statements about the present forest situation.** (Supplement 1)



Forestland Ownership in the United States

Source: USDA, Forest Service

- The best-managed forests with the highest production are owned by large industries and by the government. Because of their interests in profits, sustained-yield production, and multiple-use management, they generally follow the principles of good forestry and support scientific research to continually improve forest resources. They are staffed by professional foresters and trained forestry technicians.

- Farmers and other individual private landowners own 58%, over half, of the forested lands in the United States, and yet privately-owned lands have the poorest and least intensive management. In contrast to clear, focused industrial and government objectives, private landowners have widely different, or sometimes unclear, objectives for the use of their lands. They lack the forest management skills necessary for good productivity. Also, the land is likely to change hands over the 15-50 years needed to produce wood products.

  NOTE: Technical assistance is available through the state Forestry Division, private consultants, and USDA Cooperative Extension services in forestry and soil conservation.

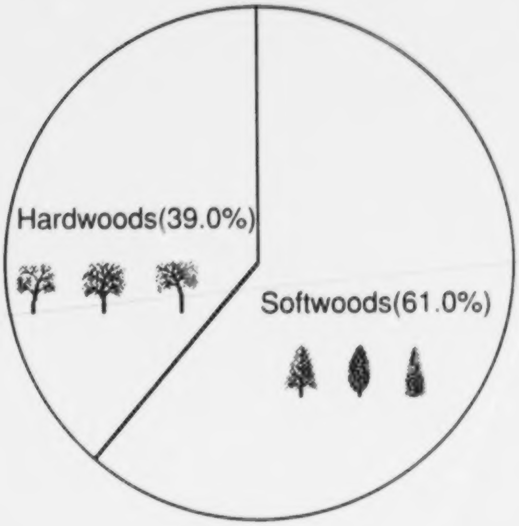
United States Timber Stands

- The United States has a large forest resource, about one-third of the total land area. But, on the whole, American forests are producing wood products far below their potential. About one-fourth of all forestland is understocked, meaning that good management practices could increase the yield. Most of the hardwood forests contain low-quality, defective trees that are not usable. Again, scientific management could improve the quality and productivity.

- The volume of total growth has increased faster than the volume of wood harvested, but the growth has been in hardwoods, while the harvest has been mostly in softwoods.

Types of timber

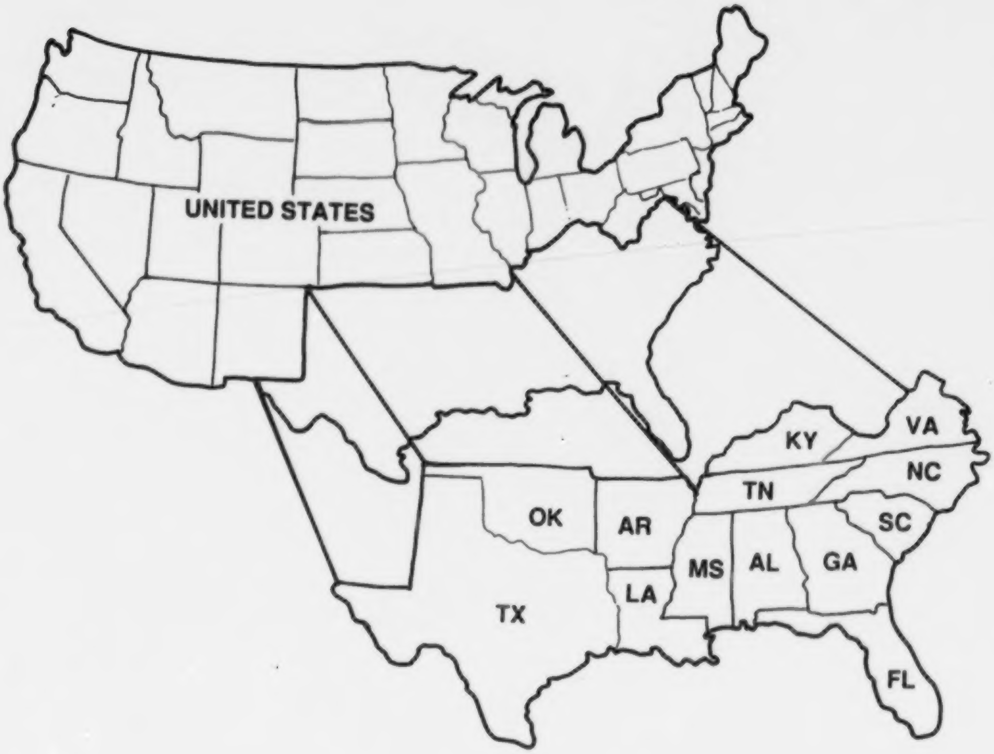
- Softwoods make up about 61% of the total volume of all classes of timber and about 2/3 or 66% of all growing stock.
- Hardwoods make up about 39% of all classes of standing timber and about 27% of all sawtimber.



OBJECTIVE 8

Choose the best word or phrase to complete statements about the importance of forests in the South.

Think of lumberjacks and timber forests. Do you see the tall, Douglas Firs of the Pacific Northwest or the hardy, Paul Bunyan types of the Northern forest? That's how TV and movies depict The American Forest, even though the West has only recently become a major timber supplier. Since the early 1900s the Southern forests have been a major force in the forest industry. This area has boomed because of warm temperatures, rich soil, and plentiful rainfall. Southern trees grow quickly and have a long growing season. In addition, the Southern forest industry has developed ways to use smaller timber, so production is faster. Excellent management—careful, scientific forestry practices to maintain, protect, and renew forest resources—is needed to insure that these areas will produce enough wood to meet the ever-growing demand for wood products in the United States.


UNITED STATES
KY
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Southern Forests

Courtesy of USDA.

- Southern forests produce a major portion of United States lumber and wood products.
  - 25% of the softwood lumber
  - 50% of the hardwood lumber
  - 40% of the hardwood plywood
  - 60% of the pulpwood
  - 62% of the paperboard
  - 56% of the newsprint

  - Over 60% of all treated wood
  - Over 50% of all particleboard, insulation board and hardboard

- The South employs one-third of America's forest industry workers, with an annual payroll of $7.5 billion. It manufactures products worth over $17 billion.

- It contains about 50% of all the nation's privately-owned timberland. Much of the timber in the West is on public land and subject to government regulations that change with political influence and keep production far below its potential. Private owners in the South can respond to market needs, and as a result the industry is more stable and more predictable.

  The down side of privately-owned timberland is that since the 1960s, 15 million acres, or about 15%, has been converted to other uses. Timberland is cleared for city areas, crops, pastures, and other nontimber uses. Moreover, many of the harvested timberlands are not being reforested.

- Today, the demand for timber products is exceeding growth and production. Furthermore, the demand is increasing at a time when available forest land is decreasing. Unless there are changes in the course of forest management for private landowners or in public consumption of products, the United States forest industry could suffer shortages, higher costs, and declining employment in the 1990s.

  Since public consumption is increasing and not decreasing, only good management can keep up with the demand. Land devoted to wood production must produce more efficiently to meet future needs. In order to keep pace with the growing demand, Southern forests need informed landowners and sharp, educated forest managers.

OBJECTIVE 9 **Distinguish between preservation and conservation.**

People often confuse preservation and conservation. The result is that the United States Forest Service comes under attack from special interest groups. For example, a group wanted to "save" the Tongass National Forest in Alaska and preserve it as a wilderness area, to keep it from being "destroyed" by the United States Forest Service. The facts were that the timber harvest was planned for only 1% of the Tongass National Forest and would take primarily overmature trees that would soon die anyway.

PRESERVATION

- In terms of land use, preservation means to set aside or leave alone.
- It comes from the word "preserve," which means "to save."
- Preserved land is not for consumptive use.

  NOTE: This means that no resources, such as timber, mineral ores (mining) or wildlife, can be removed from the forest. Nonconsumptive uses, such as hiking, canoeing (but not motorboating), camping, and photography, may be permitted.

- A preserve is like a wilderness, with no development, no roads, no structures.

  NOTE: The Wilderness Act of 1964 reserved a few million acres of National Forests and Parks and Wildlife Refuges as wilderness areas. These parks are preserved in their natural state. Visitors are allowed into the areas on foot or on horseback only. Wilderness preserves will never be harvested, no roads will be built. Fire protection relates only to the perimeter. If fires burn on the interior they are allowed to burn naturally.

- Lands set aside for preservation place a greater demand on other lands because they reduce the total amount of land available for multiple use.
- Preserved lands are used by a small percentage of the population.

CONSERVATION

- Conservation means "wise use."
- It comes from the word "conserve," which means "to keep from being damaged or wasted."
- Conservation practices insure that the best possible use will be made of the lands managed by the United States Forest Service or by other state and private industries.

  NOTE: Sustained yield, keeping a balance of resources, protection from fire and disease, improving forest and wildlife conditions, and developing technology to meet these objectives are part of conservation.

- Well-managed forest land can serve the greatest good for the greatest number over the long run.

OBJECTIVE 10

List resources considered in multiple-use forest management.

Single-use forest management would be a forest intended primarily for wood production or a section of private timberland managed as a habitat and reserved for hunting.

Multiple-use management takes into consideration all the elements of potential use and benefit, including maintenance, protection, and continuance. At one time foresters worked mainly as timber growers, but since the Multiple Use Act in 1960, they now need a working knowledge of soils, recreational planning and administration, economics and business, wildlife management, hydrology, public relations, communication, and sociology.

The ideal results of multiple-use management mean that forest soils, wildlife, water systems, range, and recreation, as well as timber, are protected and kept in a reasonable balance.

- **Timber**
- **Soil**

  NOTE: Soil is the basis for timber, forage, water, wildlife, and recreation. Soil conservation and improvement practices are important to protect the growth and balance of these other resources.

- **Wildlife**

  NOTE: Wildlife management considers timber, forage, and wildlife that can be produced together. With good management and public cooperation, wildlife can be kept in balance along with other land uses.

- **Range**

  NOTE: Forage is a major resource of certain forest land, and livestock grazing in forested areas is a multimillion-dollar industry. Again, the key to good management is keeping the balance of timber, forage, livestock, and other wildlife.

- **Recreation**

  NOTE: Recreation is one of the major uses of forest land and the surrounding water systems, such as streams, rivers, lakes, and swamps. Fishing, hunting, hiking, camping, and water sports, including the related facilities, are part of the management system. The people who use the facilities are a major consideration, requiring management to have skills in public relations and psychology, and a genuine concern for working with and helping people.

- **Water**

  NOTE: Forest land helps the retention, absorption, storage, and supply of water. Forest management practices can affect the quantity, quality, and timing of water yield. They can make an important contribution to the effects of sedimentation, pollution, fish habitat, and the aesthetic values of stream areas.

FUN FOREST FACTS

- The United States is planting 1.9 billion tree seedlings annually.
- Oklahoma's forest industry employs 7,000 people, pays $150 million in payroll, has $320 million value added and $950 million value of shipments annually.
- Oklahoma's commercial harvest (not counting firewood) exceeds 50 million cubic feet annually, enough to build 30,000 homes.
- Oklahoma has three trees which are the largest in the United States for their species: Red Mulberry, Blackjack Oak, and Western Soapberry.
- At .75 cords per person, Oklahoma requires about 80 million cubic feet annually, yet produces only about 50 million cubic feet, making us a net importer of wood.
- The per capita use of paper in China is only 13 lbs. per year. It is 613 in the United States.
- Fifty percent of our landfill space will be full within the next 5 years. Twenty percent of our waste is paper. Recycling paper saves few trees, but does extend the resource and reduces landfill needs. It also sets the stage for the major recycling efforts to come.
- One acre of trees can remove 13 tons of dust and gases each year from the environment.
- Shade trees around the home can reduce air conditioning cost by 20%.

Fun Forest Facts are provided by the Oklahoma Department of Agriculture, Forestry Division, and courtesy of the Louisiana Office of Forestry.

HOW MUCH LAND IS A MILLION ACRES?

Information from Objective 5 is as follows:

- Worldwide, excluding Antarctica, there are 130 million Km^2 (square kilometers) of total land mass and **89.9 billion acres** of it is forested.
- The United States has about **737 million acres** of forested land.
- Of this land, almost 2/3 or **483 million acres** is commercial timberland.

NOTE: One million acres is equal to about 40 square miles.

1. What is an area you know about that equals about 40 square miles? ____________________
2. How many square miles are in your state? ____________
3. How many square miles are in 737 million acres? ________
4. How many square miles are in 483 million acres? ________
5. One Km^2 is equal to 275.1 acres. How many acres are in 36.4 million Km^2? ____________________
6. How many square miles is that? ____________
7. This amount is how many times the land area of your state? ____________________

ACTIVITY SHEET 2

EXPLORE THE WORLD OF FORESTRY

I

TEST YOUR CURRENT KNOWLEDGE OF THE FOREST

When something is new to us, we can only see and understand a small part of what is there. For example, before we learn about the forest and about trees, insects, diseases, and signs of fire, our ideas of the forest are limited to what we have heard, what we've seen with an untrained eye, and to what we imagine the forest to be.

With this unit, you are entering a new world of knowledge and experience. Use this activity sheet to assess what you know now. Use Assignment Sheet 2 to actually look at and record what you observe in the forest.

At the end of this forestry course, you can complete this activity again and see how much you've learned.

DIRECTIONS

Answer the following questions. Give yourself 1 point for each answer.

Write your score here: ______________________________

You will hand this in to your teacher to be filed. At the end of the course, you can complete it again to see how much you've learned.

1. List the trees you know by sight.

____

____

____

____

2. List five jobs in forestry.

____

____

____

____

3. List five tools used to measure trees.

4. List five products made from wood that look like wood.

5. List five products made from wood that don't look like wood.

6. Name three things we can learn from looking at tree rings.

7. List the insects you know are harmful to trees.

8. Name three poisonous snakes found in your area.

____

____

____

____

9. List three methods used to control forest fires.

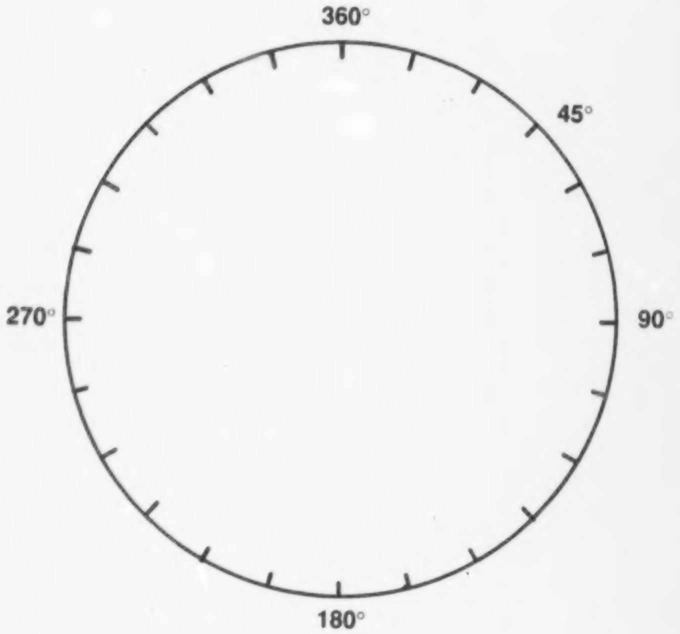
____

____

____

____

10. Draw the azimuth 90° on the compass.



11. What is the name for the science and art of managing and tending a forest?

12. List five uses of a forest.

ASSIGNMENT SHEET 1

EXPLORE THE WORLD OF FORESTRY

I

NAME ______________________________ SCORE ________

OBJECTIVE 11 **Determine local forest and forestry activities.**

INTRODUCTION

How does the forest affect you and your community? In this assignment sheet you are asked to find out what kinds of forestry activities are going on around you and what effects they have on your community. Is there a future for you in forestry? Are there opportunities in forestry? Look around, ask questions, read, and research to find out.

DIRECTIONS

Use telephone books, newspapers, maps, personal knowledge, and other people in your community to find out about the forested land in your area and about the forestry activities that go on there.

Places to find out about forested lands and activities in your area:

- State Forestry Organization (Division, Commission, Department, Bureau, etc.)
- County Extension Agents
- United States Soil Conservation Service
- State Forestry Association
- United States Department of Agriculture, Forestry Division
- Local universities and colleges
- Chamber of Commerce
- Forestry consultants

1. How much land is in your county? ______________________
2. How much of it is forested? ______________________

3. List well-known forestry operations in your area.

____

____

____

____

4. Use the yellow pages of your telephone book to find forestry-related activities such as sawmills, forestry consultants, paper mills, furniture manufacturers, and chainsaw and heavy equipment repair shops.

____

____

____

____

5. For one week, cut out newspaper articles related to forestry activities and forest reports, paste them on notebook paper and hand them in with this assignment sheet.

6. Write the name and telephone number of your County Extension Agent(s).

____

____

____

____

7. List the name, address and phone number of the head of your state USDA Forestry Division.

____

____

____

____

8. **Write the name, address and telephone number of your district forester.**

____
____
____
____

9. Name three people you know personally who work in forestry-related areas. You can include areas such as timber production, forest service, state or federal park and recreation work, wood products manufacturing such as paper mill or furniture, saw mills, timber truck drivers, forest-fire fighters, a person who cuts firewood for sale, etc.

____
____
____
____

10. Describe one privately-owned forested area near you. State where it is located and what kinds of trees you think are on the property. If you can, find out who owns it, how much land is forested, and what plans the person may have for using the area.

____
____
____
____

11. List the locations of your state forestry nurseries.

____
____
____
____

12. List the name, address, and telephone number of an agency to contact in case of a forest fire.

____

____

____

____

13. Identify forest activities in your area that are:

Owned by private industry

____

____

____

____

____

____

____

____

Publicly-owned

____

____

____

____

____

____

____

____

ASSIGNMENT SHEET 2

EXPLORE THE WORLD OF FORESTRY

I

NAME ______________________________ SCORE ________

OBJECTIVE 12 **Observe forest conditions.**

INTRODUCTION

What do you notice when you go into the forest—trees, colors, smells, underbrush, sounds? This time when you go into the forest, you can take the time to look, study, think about and record what you find there. This observation may show that you notice more than you have before. By the time you finish this course, you will notice and understand much more.

DIRECTIONS

Take a notebook or clipboard and pen and go into a stand of trees. Choose a place to stand or sit. Stay there for no less than 20 minutes. Walk around your area for another 10 minutes. Notice as much as you can and record it.

Read over the list of what to look for **before** you go. Consider these items and also any other conditions you notice on your own. Do not speak to anyone or make any noise that will frighten wildlife.

Date __________ Time of day ____________

Weather ____________________________

Location ____________________________

- Condition of trees (with or without leaves/color of leaves)

  ____

- Type of trees-as many as you can recognize

  ____

  ____

  ____

- Number of trees within a 20 ft. circle of you

  ____

- Estimate the size of the trees (5-6 inches across the trunk, 20 inches; mostly young, mostly old, mixture, etc.)

  ____

- Plants other than trees (describe them if you don't know the names)

  ____

  ____

  ____

- Amount of moisture (very dry, very wet, slightly dry, etc.)

  ____

- Smells

  ____

  ____

- Ground covering

  ____

  ____

- Texture of the ground underfoot

  ____

- Look at the bark of 15 trees for interesting signs such as insect burrows, animal hair in the bark, machine damage, fungus such as mushrooms or colored areas, paint marks, woodpecker holes or other bird signs.

  ____

  ____

  ____

- Sit or lie in one place and look up into the branches. Count the broken or loose limbs you see hanging.

  ____

- Look at the color of the leaves or needles. Look for differences in colors on the same tree or among the different kinds of trees.

  ____

  ____

- Sounds

  ____

  ____

- Insects, small animals and other wildlife

  ____

  ____

- Scars or marks on trees

  ____

  ____

- Pick up two different kinds of leaves from the forest floor. Describe them.

  ____

  ____

  ____

  ____

- Dig down about 4 inches into the soil. What do you find?
- Signs of man

  ____

  ____

- Color of the sky

  ____

- Feeling in the air (temperature, moisture, air changes, crisp, muggy, etc.)

  ____

NOTE: These assignment sheets are investigative and subjective. It is recommended that they be evaluated on a satisfactory-unsatisfactory basis.

ASSIGNMENT SHEET 1

- Check that students completed the assignment sheet as far as possible for your locale.
- Newspaper clippings should accompany the assignment sheet.
- Check that answers are reasonable and appropriate.

ASSIGNMENT SHEET 2

- Check that all items are completed.
- Check that answers are reasonable and appropriate.

WRITTEN TEST

EXPLORE THE WORLD OF FORESTRY

I

NAME ______________________________ SCORE _______

OBJECTIVE 1

Match terms associated with exploring the world of forestry to their correct definitions. Write the correct letters in the blanks.

____ 1. Broadleaved trees

____ 2. Having to do with cities

____ 3. Needle-leaved trees that retain their leaves in the winter

____ 4. Fungi, viruses, and bacteria that contribute to the life cycle of all organisms

____ 5. Done primarily for sale or profit

____ 6. An area in which all the draining or runoff flows into a given stream

____ 7. Something owned by a state, country, organization or individual that can be used to its advantage

____ 8. Continual, permanent production from commercial timberland

____ 9. The interaction of all living things and their environment in the same area

____ 10. Minerals that promote growth and development

____ 11. Animals that eat the flesh of other animals

____ 12. The study of human society

____ 13. Animals that eat mostly grass and other green plants

a. Carnivores
b. Commercial
c. Downtown
d. Drainages
e. Ecosystem
f. Hardwood
g. Herbivores
h. Insects
i. Mammals
j. Microorganisms
k. Nutrients
l. Profits
m. Psychology
n. Resource
o. Sociology
p. Softwood
q. Sustained yield
r. Urban
s. Watershed

OBJECTIVE 2

Define forest and forestry.

1. Forest—

2. Forestry—

OBJECTIVE 3

List the elements of a forest community.

OBJECTIVE 4

Select from a list true statements about the importance of trees and forests. Write an "X" in the blank before each correct answer.

____ 1. Forests influence the climate by creating cold fronts around the globe.

____ 2. Small, local forests can create temperature differences (cooler in summer, warmer in winter), windbreaks, and moisture storage, especially in urban areas.

____ 3. Good forest management can control water flow and aid in flood prevention.

____ 4. The forest provides a better natural habitat for carnivores than for herbivores.

____ 5. Protection from wind damage is more important around urban areas than around rural areas, especially in cities with tall buildings.

____ 6. Good forest management can increase the rainfall in dry areas.

____ 7. It's estimated that about 5,000 different products are made from wood.

____ 8. The health and balance in a forest affects the ecosystem and the food chain.

____ 9. Forests reduce surface runoff, helping to regulate the flow of water in streams and rivers.

____ 10. Large forested areas, such as the tropical rain forests of Brazil, generate huge volumes of clouds that affect the way heat is distributed around the globe.

____ 11. Forests prevent soil and wind erosion because the canopy of leaves keeps rain and wind off the forest floor.

____ 12. Trees remove pollutants from the air, soil, and water.

OBJECTIVE 5

Complete statements about the amount of forested land worldwide and in the United States.

1. Worldwide, excluding Antarctica, there are 3.21 trillion acres of total land mass and ________________ of it is forested.
2. The United States has about ______________ of forested land.
3. Of this land, almost 2/3 or ______________ is commercial timberland.

OBJECTIVE 6

Choose the best word or phrase to complete statements about the history of forestry in the United States. Circle the correct answers.

1. The major use of wood during the 1600s-1800s was for ______ .
    a. housing
    b. fuel
    c. furniture
2. The most severe deforestation period occurred during the ______ .
    a. 1600s
    b. 1700s
    c. 1800s
    d. 1900s
3. The first forest protection laws were to ______ .
    a. reduce the number of forest fires
    b. provide for clean water and wildlife habitat
    c. insure fuel supplies
    d. save live oaks and redcedar for shipbuilding
4. The state that initiated Arbor Day was ______ .
    a. Wisconsin
    b. Minnesota
    c. Oregon
    d. Michigan
    e. Illinois
    f. Nebraska

5. The turning point in forestry legislation was the 1875 founding of the _____ .
   - a. American Forestry Association
   - b. Department of Agriculture
   - c. Forest Service
   - d. Department of the Interior

6. In 1905 the Forest Service became part of the Department of _____ .
   - a. the Interior
   - b. Conservation
   - c. Agriculture
   - d. Justice

7. The 1920s saw the first _____ .
   - a. forest conservation legislation
   - b. sustained-yield management program
   - c. wildlife protection act

8. The Civilian Conservation Corps, the Tennessee Valley Authority and the Soil Erosion Service were established in the 1930s under President _____ .
   - a. Theodore Roosevelt
   - b. Franklin D. Roosevelt
   - c. Harry S. Truman
   - d. Richard M. Nixon

9. The Forest Service developed "A National Plan for American Forestry" calling for all of the following EXCEPT _____ .
   - a. a large extension of public ownership of forest lands
   - b. more intensive management on all forest lands
   - c. appropriation of public lands for logging
   - d. public control over private forest cutting practices

10. The amount of forest land under some kind of management today is approximately ______ .

  a. 20%

  b. 30%

  c. 40%

  d. 50%

11. Legislation since 1945 has improved the distribution of funds. Before 1945, most expenditures went for ______ .

  a. harvesting

  b. management

  c. fire protection

  d. reforestation

12. Emphasis on conservation marked the ______ .

  a. postwar years, 1945-1947

  b. 1950s

  c. 1960s

  d. 1970s

OBJECTIVE 7

Choose the best word or phrase to complete statements about the present forest situation. Circle the correct answers. Questions may require more than one answer.

1. United States timber stands are producing ______ .

  a. over half the world's wood supply

  b. low-quality softwoods and hardwoods

  c. far below their potential

  d. at full potential

2. Of the types of timber harvested, ______ .

   a. softwoods make up about 61% of the total volume of all classes of timber and about 66% of all growing stock

   b. softwoods make up about 58% of the total volume of all classes of timber and about 83% of all growing stock

   c. hardwoods make up about 62% of all classes of standing timber and about 36% of all sawtimber

   d. hardwoods make up about 39% of all classes of standing timber and about 27% of all sawtimber

3. Private landowners ______ .

   a. own over half of the forested land and have the poorest management

   b. are in strong competition with large industrial and government forestry operations

   c. may have unclear or divergent objectives for the use of their lands

   d. are motivated by the profits from long-term ownership

4. The volume of total growth has increased faster than the volume harvested. This increase has been ______ .

   a. in softwoods, while the harvest has been primarily hardwoods

   b. in hardwoods, while the harvest has been primarily softwoods

   c. in both wood types, while the harvest has been primarily softwoods

   d. in both wood types, while the harvest has been primarily hardwoods

OBJECTIVE 8

Choose the best word or phrase to complete statements about the importance of forests in the South. Circle the correct answers.

1. The forest that is more stable and predictable is the ______ .

   a. Southern Forest

   b. Western Forest

2. Southern forests manufacture products worth over ______ .

   a. $76 billion

   b. $100 billion

   c. $44 billion

   d. $17 billion

3. Southern forests contain ______ percent of all the nation's privately-owned timberland.

   a. 25%

   b. 35%

   c. 50%

   d. 60%

4. Southern forests need ______ .

   a. informed landowners and sharp, educated forest managers

   b. genetically improved, drought-resistant trees

   c. fewer hardwood stands and more softwood forests

5. Southern forests supply more than half of the United States production of the following, EXCEPT ______.

   a. paperboard

   b. particleboard

   c. softwood lumber

   d. treated wood

6. The fraction of America's forest industry that is employed in the South is ______ .

   a. 1/4

   b. 1/3

   c. 1/2

   d. 3/4

7. In the Southern forest ______ .

   a. industry will be able to meet growing demands in the 1990s

   b. the demand for timber products is exceeding growth and production

   c. private landowners are reforesting to keep up with demand

   d. government regulation will enforce reforestation practices

OBJECTIVE 9

Distinguish between preservation and conservation. Write a "P" in the blanks before statements that refer to preservation and a "C" in the blanks before statements that refer to conservation.

____ 1. Comes from a word meaning "to keep from being damaged or wasted"

____ 2. Land is not for consumptive use

____ 3. Means to set aside or leave alone

____ 4. Insures that the best possible use will be made of the land

____ 5. Comes from a word meaning "to save"

____ 6. Land like a wilderness, with no development, roads, or structures

____ 7. Means "wise use"

____ 8. Used by a small percentage of the population

____ 9. Can result in the greatest good for the greatest number over the long run

____ 10. Reduces the total amount of land available for use

OBJECTIVE 10 **List resources considered in multiple-use forest management.**

NOTICE The following assignment sheets are not part of the written test. If these activities have not been completed, check with your instructor.

OBJECTIVE 11 **Determine local forest and forestry activities.** SCORE ________

OBJECTIVE 12 **Observe forest conditions.** SCORE ________

WRITTEN TEST ANSWERS

EXPLORE THE WORLD OF FORESTRY

I

OBJECTIVE 1

1. f
2. r
3. p
4. j
5. b
6. s
7. n
8. q
9. e
10. k
11. a
12. o
13. g

OBJECTIVE 2

1. Forest—A living, self-renewing ecosystem involving a complex association of plants and animals in which each individual plays some part in the life of the community
2. Forestry—Work concerned with the multiple use of forest lands and resources, including their management and protection

OBJECTIVE 3

- Trees
- Plants
- Shrubs
- Soil
- Water
- Animal life
- Human life
- Fire

OBJECTIVE 4

2, 3, 7, 8, 9, 10, 12

OBJECTIVE 5

1. 89.9 billion acres
2. 737 million acres
3. 483 million acres

OBJECTIVE 6

1. b
2. c
3. d
4. f
5. a
6. c
7. b
8. b
9. a
10. c
11. c
12. d

OBJECTIVE 7

1. c
2. a, d
3. a, c
4. b

OBJECTIVE 8

1. a
2. d
3. c
4. a
5. c
6. b
7. b

OBJECTIVE 9

1. C
2. P
3. P
4. C
5. P
6. P
7. C
8. P
9. C
10. P

OBJECTIVE 10

- Timber
- Soil
- Wildlife
- Range
- Recreation
- Water

OBJECTIVE 11 Refer to answers to Assignment Sheet 1.

OBJECTIVE 12 Refer to answers to Assignment Sheet 2.

OBJECTIVE SHEET

INVESTIGATE FORESTRY CAREER OPPORTUNITIES

II

INTRODUCTION

Forestry appeals to a wide variety of interests. Young people are drawn to it because they love the outdoors, they are concerned about the environment, they are interested in the sciences and see forestry as a way to pursue their interests. The opportunities for satisfying careers in forestry are enormous. In this unit, you will have the chance to investigate what areas of forestry appeal to you, and learn for yourself, first-hand, about the working world of professional foresters and forest workers. You'll be able to understand why people choose forestry and why they stay with it.

PREREQUISITES

None

UNIT OBJECTIVE

After completing this unit, the student should be able to identify the types of forestry careers, areas of study in forestry, educational and personal requirements, advantages and disadvantages of working in forestry, and demonstrate communication skills involved in forestry. The student will demonstrate these competencies by completing the assignment sheets and written test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with forestry careers to their correct definitions.
2. Select from a list true statements about the forestry profession.
3. Match areas of study in forestry to their correct definitions.
4. State educational requirements for nonprofessional and professional forestry positions.
5. Select from a list personal requirements for a career in forestry.
6. List advantages and disadvantages of a forestry career.
7. Match organizations that employ people trained in forestry to their descriptions.
8. Identify the communication skills required in given situations.
9. Identify state and local employment opportunities. (Assignment Sheet 1)
10. Write a thank-you letter. (Assignment Sheet 2)

11. Outline a presentation on forestry careers. (Assignment Sheet 3)

12. Give a presentation about a career in forestry. (Assignment Sheet 4)

SUGGESTED ACTIVITIES

INVESTIGATE FORESTRY CAREER OPPORTUNITIES

II

PREPARATION

- Obtain materials to supplement unit.

  NOTE: See Suggested Resources.

- Review instructional outline for this unit. Modify time frames to suit class needs and plan activities for each class period.

  - Allow 3 weeks preparation time plus class time for oral presentations and discussion/critique. A 3-5 minute speech will take 8-10 minutes of class time.

- Study the specific objectives to determine those you will cover in your presentation. Decide which objectives should be taught to which students.

- Determine scope and sequence of objectives that you add. Design and develop support materials, including evaluation techniques, for additional objectives.

- Review teaching suggestions and plan classroom activities.

- Determine how you will schedule time for students to demonstrate competence in the required procedures.

- Identify supplemental learning activities in *Project Learning Tree.*

- Use newspapers from other states to compare the cost of living and forestry salaries as reported in Student Supplement 1.

- Invite a forestry worker or aide, a technician and a professional forester to talk about careers in forestry.

- Invite a professional speaker or speech teacher and a public relations representative or writer to talk about communication skills.

  NOTE: Supply guest speakers with the specific objectives and other appropriate sections of the unit.

- Make enough copies of Teacher Supplement 3, the speech evaluation sheet, so that each student will be able to evaluate the students speaking.

DELIVERY

Objectives 1 and 2

- Introduce the unit. Discuss local career and employment opportunities. Ask students to tell what they think a forestry career would be like.
- Review terms with students.
- Post the flyer and Oklahoma Youth Forestry Camp information in Teacher Supplement 1.
- Invite a professional forester to talk with the class.

Objective 3

- Have students write a list of their interests, hobbies, role models, especially in the sciences; find comparable areas among the fields of study in this objective.
- Discuss the variety of interests available in forestry.

Objectives 4 through 6

- Refer students to Supplements 2 and 3.
- Refer students to Supplement 4 for a description of personal requirements for the educational levels of forestry careers.
- Discuss salary scales in Supplement 1. Talk about cost of living.
- Compare state forestry salaries to teacher salaries.
- Compare forestry salaries in your state and two surrounding states.
- Have students complete Activity Sheet 1.

Objective 7

- Refer students to Supplement 5.
- Have students complete the class project in Assignment Sheet 1, using Supplement 6 to locate appropriate agencies and people.

- Oklahoma teachers can photocopy or write the information in Teacher Supplement 2 on the board. Teachers in other states should provide students with addresses and phone numbers for the State Forestry Division, university and forestry extension departments, state conservation commission, state parks and recreation departments, etc.

Objective 8

- Stress that forestry involves working with people. Discuss the importance of good communication skills.
- Have students complete Assignment Sheet 2.
- Assign speech presentation outline in Assignment Sheet 3 and presentation times for Assignment Sheet 4.
- Review Supplement 7 with students. Suggest topics of local interest.
- Go over the outline procedure in Assignment Sheet 3 to prepare students for the presentation.
- Invite a professional speaker or speech teacher to review the characteristics of a good speech.
- Invite a forestry public relations representative or a writer to discuss PR and writing skills.
- Use *ReLeaf* materials as examples of promotional materials.
- Plan a class project that requires writing news releases.

APPLICATION

Objective 9

- Use Assignment Sheet 1 to provide students with the experience of researching resources. This is a class project in which all students are expected to participate.
- Assignment Sheet 1 is a direct example of group communication processes. After each meeting session, ask students to evaluate the communication activities involved, such as how open the communication was, what difficulties emerged, whether there was a sense of cooperation, whether everyone participated and all opinions were respected.

Objective 10

- Use Assignment Sheet 2 to teach letter-writing skills and to reinforce good business manners.

Objective 11

- Use Assignment Sheet 3 to give students the experience of organizing information and planning the presentation; reinforce outlining skills.

Objective 12

- Use Assignment Sheet 4 to give students the opportunity to stand up before a group and deliver an organized presentation.

EVALUATION

Written test

- Explain to students that they will be asked to demonstrate on the written test actions listed in the specific objectives.
- Give written test.

  NOTE: The written test may be given in sections if desired.
- Evaluate students on assignment sheet activities if not previously done.
- Reteach and retest if necessary.
- Complete appropriate section of competency profiles.
- Review individual and group performance in order to evaluate teaching methods. Adjust scope, sequence, or instructional approaches for additional lessons as required.

SUGGESTED RESOURCES

Publications

- *A Job With the Forest Service: A Guide to Career Opportunities in Technical Support Positions*, Miscellaneous Publication No. 1395, United States Department of Agriculture, 1981. Describes positions, GS ratings, qualifications and requirements for nonprofessional employment with the Forest Service; lists national forests, research headquarters, technical training programs and Federal Job Information Centers. May be available through your state forestry department; can be ordered from the U.S. Government Printing Office, Washington, D.C. 20240.

- *So You Want to Be in Forestry*, American Forestry Association and The Society of American Foresters. Available from Society of American Foresters, 5400 Grosvenor Lane, Bethesda, MD 20814-2198. Small charge per copy.

- *Opportunities Unlimited—In the Forest Product Industries*, free from National Forest Products Association, 161 Massachusetts Avenue, NW, Washington, DC 20036.

- *Men Who Matched the Mountains: The Forest Service in the Southwest*, Edwin A. Tucker and George Fitzpatrick, published by Forest Service, Southwestern Region. The story of professional foresters and the Forest Service. Students can request this book from a local library or from interlibrary loan.

- *Project Learning Tree*, American Forest Council, 1250 Connecticut Avenue NW, Washington, D.C. 20036, 1986. The activity book can be obtained only by attending *Project Learning Tree* Teacher Workshops. Contact your County Extension Agent or state Forestry Division for information.

Speakers

- *Oklahoma Natural Resources Speakers Bureau* sponsored through Oklahoma State University, Division of Agriculture, Oklahoma Cooperative Extension Service - Forestry, Oklahoma Conservation Commission and the Oklahoma Forestry Association. Lists speakers on a variety of forestry-related topics. Speakers operate on a time-available basis. Request a listing of speakers, programs, slide presentations and videotapes from your local extension office or from:

Dr. Steve Anderson
Forestry Dept.
Oklahoma State University
239 Agricultural Hall
Stillwater, OK 74078
(405) 744-9431

Dave Marcouiller
Forestry Dept.
Oklahoma State University
242 Agricultural Hall
Stillwater, OK 74078
(405) 744-5444

Audiovisual Materials

- *Careers in Conservation*, 45 slides with cassette, 6 min. Describes the different areas of Soil Conservation Service work and the career opportunities with SCS. Available on a free-loan basis from Oklahoma SCS Office, USDA, Agricultural Center Office Building, Stillwater, OK 74074, (405) 624-4360. Teachers outside of Oklahoma should contact the local Soil Conservation Service office.

- *Oklahoma Youth Forestry Camp Promotion*, 1/2" VHS, color, 6 min., Oklahoma State University Agriculture Information, 1988. Gives an overview of what youth forestry camp is and encourages young people to enroll in the camp. Order Number VT75, available from Oklahoma State University Agriculture Information Library, (405) 744-6886 or from Oklahoma State University Forestry Extension, (405) 744-5444 or 744-9431.

- *Trees for 2001: Today's Foresters in Action*, 17 min, 116 slides with cassette tape and script, American Forest Institute. Covers basic concepts of forest management through the eyes of people in forest-related jobs. Helps students develop an understanding of how and why forests are managed. Available on a free-loan basis from the Forestry Extension Program at Oklahoma State University, 242 Agricultural Hall, Stillwater, OK 74078, (405) 744-5444 or 744-9431.

NOTE: The following materials are available on a free-loan basis from the Forestry Extension Program at Oklahoma State University, 242 Agricultural Hall, Stillwater, OK 74078, (405) 744-5444 or 744-9431.

- *4-H Round Up Short Course - Forestry Section - Conservation of Natural Resources*, 14 slides with script, OSU Extension Forestry. Gives a broad overview of Conservation of Natural Resources; refers to opportunities for 4-H involvement.

- *The 4-H Forestry Leader - 1975*, 66 slides with script and cassette, Oklahoma State University Extension Forestry.

- *4-H Forestry: An Action Program*, 189 slides with script and cassette, National 4-H Service Committee.

Other media

- Obtain information on planting trees and Arbor Day Kit from:

  American Forestry Association
  Global ReLeaf Program
  P.O. Box 2000
  Washington, D.C. 20013
  Telephone: (800) 368-5748

The Arbor Day Kit contains ideas for Arbor Day events, a list of state ReLeaf coordinators, information on where to get technical assistance, sample media advisory, Arbor Day song list, sample feature article for local media, checklist for a press conference, Global ReLeaf poster, Global ReLeaf/Arbor Day proclamation and resolution. The objective of ReLeaf is to plant 100 million trees by 1992.

- Obtain information on summer employment opportunities in forestry from:

  Youth Conservation Corps
  Ouachita National Forest
  P.O. Box 1270
  Hot Springs, Arkansas 71902
  Attn: Personnel Officer

- Contact your state organizations for current publications, statistics and other materials related to forestry in your area.

UNIT REFERENCES

- *A Job With the Forest Service: A Guide to Career Opportunities in Technical Support Positions*, Miscellaneous Publication No. 1395, United States Department of Agriculture, 1981.
- Anderson, David A. and I. I. Holland, *Forests and Forestry*, The Interstate Printers & Publishers, Inc., Danville, Illinois, 1982.
- Collins, B. McManus, and Fred M. White, *Elementary Forestry*, Reston Publishing Company, Reston, Virginia, 1981.
- *Forestry Aide Curriculum for Native Americans*, Arizona Center for Vocational Education, Flagstaff, Arizona, 1984.
- *Harvesting Forestry Products*, Texas A&M University, College Station, Texas, 1976.
- *So You Want to Be in Forestry*, American Forestry Association and The Society of American Foresters, n.d.

OKLAHOMA YOUTH FORESTRY CAMP

Forestry: Oklahoma Style

Looking for something fun and interesting to do this summer? How about spending a week in one of Oklahoma's most scenic areas?

The Oklahoma Youth Forestry Camp, sponsored annually in early June at Beavers Bend State Park in southeastern Oklahoma, promises fun and excitement.

The camp provides participants the opportunity to see many facets of the forestry profession.

Planned events may include:

- exploring one of the largest forest industries in the south;
- observing a logging operation;
- climbing to the top of a forest-fire lookout tower;
- meeting a well-known naturalist and handling exotic animals.

If this camp sounds good to you, don't delay -- call your OSU County Extension office. Additional information, including video tapes and a slide-tape program, is available through your local Extension office. Registration deadline is May 30.

OKLAHOMA YOUTH FORESTRY CAMP

Every June the Cooperative Extension Service holds an Oklahoma Youth Forestry Camp at Beaver's Bend State Park, Broken Bow, Oklahoma. The six day camp is open to all Oklahoma young people between 14 and 18 years old.

The program is intended to increase awareness of natural resources and to provide an opportunity to learn firsthand and hands-on what forestry is like as a career option.

Students have programs and activities in surveying, tree measurement, multiple resources, forest protection and Project Learning Tree.

A student can return to the camp every year until the age of 18.

The cost is $45 and includes programs, room and board and field trip transportation.

Contact:
Forestry Extension
Division of Agriculture
242 Agricultural Hall
Oklahoma State University
Stillwater, OK 74078
(405) 744-5444

INVESTIGATE FORESTRY CAREER OPPORTUNITIES

ODA Forestry Division
2800 N. Lincoln Blvd.
Oklahoma City, OK 73105
(405) 521-3864, x 288

Forest Service - USDA
P.O. Box 96090
Washington, D. C. 20090-6090

Public Affairs Office
Forest Service
201 14th St. SW
Washington, D.C. 20250
(202) 447-3957

Oklahoma Forestry Association
Box 517
Broken Bow, OK 74728
(405) 584-6911

Forestry Department
Oklahoma State University
013 Agricultural Hall
Stillwater, OK 74078
(405) 744-5437
(Accredited professional forestry program, Bachelor's and Master's degrees)

Forestry Department
Eastern Oklahoma State College
Wilburton, OK 74578
(Accredited technical forestry program)

USDA Field Station
2000 18th
Woodward, OK 73801
(405) 254-3213

OSU Cooperative Extension Service, Forestry
242 Agricultural Hall
Oklahoma State University
Stillwater, OK 74078
(405) 744-6432

Oklahoma Conservation Commission
2800 N. Lincoln Blvd.
Oklahoma City, OK 73105

TEACHER SUPPLEMENT 3 | **INVESTIGATE FORESTRY CAREER OPPORTUNITIES** **II**

SPEECH EVALUATION SHEET

Student's Name ______________________________ Grade __________

Topic	Excellent	Good	Fair	Poor	Not included
INTRODUCTION					
Got audience's attention					
Related to audience					
Clearly stated topic					
Topic sufficiently narrow					
CONTENT AND STRUCTURE					
Main points were clear					
Developed ideas logically					
Used transitions					
Summarized main points					
Conclusion ended the speech clearly					
DELIVERY					
Could be heard					
Willingness to share with the audience (confidence)					
Eye contact					
Physical expressiveness (face, gestures, movement, ease)					
Overall effectiveness					
Excellent - 4, Good - 3, Fair - 2, Poor - 1, Not included - 0					
Totals					

OBJECTIVE 1

Match terms associated with forestry careers to their correct definitions.

- **Advocate**—To speak or write in support of something
- **Aesthetic**—All the aspects related to beautifying or improving the appearance of a particular environment
- **Clearcutting**—The removal of an entire standing crop of trees

  NOTE: It is rare that an entire area is left without any standing trees. Usually, clearcutting refers to logging operations that leave many unsalable trees standing.

- **Consultant**—A professional forester whose services are available to the general public on a contract or fee basis, with the fee paid by the client
- **Cruise**—To estimate the volume of standing timber
- **Ecology**—The scientific study of the relationship of living things to one another and to their environment
- **Environment**—The total of all surrounding things, conditions, or influences, especially as they affect the existence or development of nature and of people
- **Forage**—Plant material of any kind available for animals to eat

  NOTE: When forage is cut, it becomes feed.

- **Interpersonal**—Between or among people
- **Inventory**—Determining how many, where, how, and if trees should be harvested to meet economic, environmental, and aesthetic goals
- **Lobbying**—Trying to get legislators to vote for measures favorable to a special interest, such as forestry
- **Pulp**—Mechanically ground or chemically digested wood used to make wood products

  EXAMPLES: Paper, fiberboard, rayon, and other products.

- **References**—On a job application form, the names, addresses, and phone numbers of people who can tell an employer about your work abilities and character

- **Regeneration**—The renewal of a tree crop by natural or artificial means

  NOTE: Regeneration includes nurturing the soil so that new seeds or seedlings can grow; planting new trees following timber cutting, fire, disease, erosion, or other problems (also called reforestation).

- **Suppression**—The procedures used to extinguish a forest or grass fire

- **Urban**—Referring to cities

- **Valuation**—Estimating the economic worth of timber and determining ways to increase, manage and protect the worth of timber and forest products

- **Watershed**—A drainage system; the area from which all the run-off flows into a particular stream

OBJECTIVE 2

Select from a list true statements about the forestry profession.

- **The profession of forestry**

  Forestry is not only working with trees, it also involves working with people and teaching them about forests. Liking people is the key to a successful career. Success in forestry doesn't mean getting rich, it means doing well at your work, helping the environment and helping people, and enjoying it.

Courtesy USDA, Forest Service.

Forestry is considered a profession, just as medicine, law, and architecture are professions. One characteristic of a profession is that advancement comes through education. You can't "work your way up" from the lower levels to the higher levels.

- **Outdoor and indoor work**

  Almost all the people working in forestry enjoy the beauty and space of the outdoors and enjoy and take pride in their knowledge of trees, wildlife and the environment. That's why they became foresters—they have a deep feeling of appreciation for the environment and are at home in the forest. Many professional foresters spend a lot of time outdoors, while others have careers that involve primarily indoor work.

  For the first few years of a career, foresters usually work in the field getting on-site experience and supervising work crews. Entry-level people have to be able to withstand the rigors of the woods, such as insects, poison ivy, and cold, hot, wet, and dry conditions. As they get more experience, there are usually job advancements into administrative levels.

- **Career advancement**

  In forestry, as in most professions, as employees work longer at their careers, they are given more responsibility. Eventually, they will spend more time working at a desk and less time doing physical work in the field. The manager plans and makes decisions, reads and writes reports, and manages budgets. Instead of working in the forest, experienced foresters are contracting, training others, and serving as advisors and consultants.

Courtesy USDA, Forest Service.

Advances in pay and responsibilities continue as employees gain experience. Many foresters are hired as top executives in private industry, government agencies, and conservation organizations.

- **Variety of career opportunities**

  Forestry researchers work in the lab; statisticians, planners, and fire-fighting managers work with high-tech computers and equipment. Economists study trends in growth, lumber and productivity. The professionals contribute to the policies and activities of the forestry profession. The actual "hands-on" work is carried out by non-professional, technical personnel such as loggers, timber cruisers, yard workers, fire fighters, forestry technicians or forestry aides.

- **Advantages of a career in forestry**

  As a profession, forestry pays less than some others, but working conditions, stress factors, opportunities and job variety are better than in many other careers.

  NOTE: See Supplement 1 for a comparison of pay scales.

  Foresters know they will receive less pay, but they feel that a good working environment and the other benefits are equal to or more important than the money.

Courtesy USDA, Forest Service.

IT TAKES 15-50 YEARS FOR A FOREST TO GROW

Forestry works on a grand time scale, planning for 15-50 years in the future. The ultimate goal is to produce a forest and the results may not occur within your career or even within your lifetime. No other profession is like this.

NOTE: The length of time before harvest depends on the level of management and the desired end product. First thinnings of small trees occur about 15 years after stock is planted, the final harvest of mature trees can occur at about 50 years.

Courtesy USDA, Forest Service.

People in natural resource professions enjoy sharing knowledge with others. They like being a part of the whole of the earth's ecology. They feel an obligation to society to help us use our resources wisely, to nurture and improve them, and to protect them from unnatural damage, misuse, and loss.

OBJECTIVE 3 **Match areas of study in forestry to their correct definitions.**

- **Business administration**—Carrying out guidelines, policies and procedures to maintain smooth operation

  NOTE: Administration includes personnel (hiring, solving problems, firing), payroll and clerical support for an organization.

- **Dendrology (den-DRAHL-uh-gee)**—The identification and classification of trees

  NOTE: Dendrology is the study of trees and is the most basic part of a forestry education. Unit 4, "Determine Patterns of Tree Growth and Classification" will give you a taste of studying dendrology.

- **Forest ecology (silvics)**—A science covering the life history and general characteristics of forest trees and stands, with a focus on ecological factors

  NOTE: Forest ecology is the science concerned with how living and nonliving factors influence tree growth. It includes such things as how bacteria and animals affect a stand; how rain, wind, and soil affect tree growth, and how other plants and trees interact. It includes the study of biology and ecology. Unit 4, "Patterns of Tree Growth" is an introduction to forest ecology.

- **Forest economics**—Study of financial analyses related to forestry and how forestry impacts local, state, regional, national and international economies; includes valuation and inventory to the individual forest owner

  NOTE: Individual forest owners must be aware of the principles of forest economics because these principals determine whether owners make or lose money.

- **Forest management**—The practical application of scientific, economic, and social principals to the operation of forest property; includes valuation and inventory

Courtesy USDA, Forest Service.

- **Forest protection**—Methods of fire prevention and suppression; insect and disease control; guarding against animal and wind damage; education and enforcement to control human damage and misuse of forests

  NOTE: Units 14 and 15 will tell you about the kinds of damage fire, insects and diseases can do to forests and how we can help prevent this damage.

- **Forest recreation**—Managing tourist or visitor populations and also managing the natural resources involved in leisure-time activities in the forests and watersheds

Courtesy USDA, Forest Service.

- **Forest utilization**—Harvesting and marketing the forest crop and other resources of the forest which are made into various forest products; includes valuation and regulation

  NOTE: Forest products are everywhere in our lives. Unit 3 and Unit 16 will introduce you to the wide range of forest products and teach you some basic utilization practices.

- **Genetics**—The study of plant populations and their breeding characteristics

- **Hydrology**—The study of watersheds and water movement as they relate to forest management practices

- **Measurements**—Determining the volume and growth of logs, single trees, and timbered areas to predict production and yield; includes valuation and regulation

  NOTE: Measurements appeal to people who like to work outside and who enjoy math. Unit 9, "Practice Tree Measurement" will give you the opportunity to do some measurements that foresters do. In Units 10-12 you'll learn to survey and measure land, use land descriptions and how to cruise timber (estimate the value of tree stands), all essential forestry skills.

- **Plant pathology**—The study of plant diseases and disorders

  NOTE: A plant pathologist studies how diseases spread, how they affect all parts of the tree; and how trees cope with and recover from diseases or natural disorders that reduce the value of timber.

- **Policy making**—Determining desirable strategies and actions for the greatest good and the least harm; uses valuation and regulation studies to make decisions

  NOTE: The U.S. Legislature is the policy-making body of the federal government. Forestry laws and regulations are recommended and set by federal agencies such as the U.S. Department of the Interior, the Bureau of Land Management, the USDA Forest Service and by state and local governments. In addition, each federal, state or private forest facility will have its own ordinances regarding fire, trespassing, hunting, etc.

- **Public relations**—Communications; working with the public and with corporations, institutions and legislators to create greater understanding, awareness and recognition of values and issues related to forestry

  NOTE: "PR" can include writing brochures and booklets, producing radio, television programs and movies related to forestry; public speaking in the form of talking to hikers and school children; lobbying in Congress; creating public education programs such as Smokey the Bear, Woodsy Owl, and Project Learning Tree; and providing information on emotional issues such as clearcutting, harvesting our national forests, protecting wildlife and other environmental concerns.

- **Silviculture**—The application of scientific principles to cultivating forest trees for maximum yields of crops and uses

  NOTE: Harvesting techniques include regenerating the forest and using selective cutting to promote the best growth of the best trees; working with soil characteristics, water drainage, and other factors to produce the best possible growth. Silviculture looks at the big picture, from harvesting and replanting, to caring for trees and land until the next harvest. Unit 13 "Apply Forest Management Practices" will introduce you to some silviculture techniques.

- **Soils Science**—The chemical, physical and biological properties of soils that support trees and other forest vegetation; the protection against its loss and erosion and the conservation and management of forest soils

  NOTE: In your agriculture program, you may have studied some of the basic elements of soil, such as structure, type (loam, sand, clay) and soil formation.

- **Urban forestry**—Taking care of trees in cities

  NOTE: Urban forestry is a combination of forestry and arboriculture. Individual trees in the city are more valuable than individual trees in the forest. Their products are not physical, like timber, but are more intangible things, such as shade, air pollution control, beauty, energy conservation, and urban wildlife habitat.

- **Utilities forestry**—Managing forested areas surrounding electric or telephone lines

  NOTE: Utilities forestry is an emerging field. Using inventories and statistical analysis of growth rates and species, the forester manages tree trimming cycles and controls vegetative growth to keep utility and telephone lines clear.

- **Wildlife and fisheries management**—Maintaining habitats and regulating populations of game and nongame animals and fish

Courtesy USDA, Forest Service.

NOTE: Game are animals hunted for food or sport, such as deer, elk, moose, pheasant, wild turkeys, and fish. Nongame wildlife are animals that are not hunted, such as wrens, snakes, mice, bats, badgers, etc.

- **Wood technology**—Chemical and physical properties of various types of woods; their behavior in different weather and moisture conditions; and their various uses

NOTE: Wood technologists and utilization experts work together to get the best use of wood products.

OBJECTIVE 4

State educational requirements for nonprofessional and professional forestry positions. (Supplements 2, 3, and 4)

LEVEL 1—Forestry workers or aides and forestry technicians

NOTE: See Supplements 2 and 3 for brief job descriptions of nonprofessional forestry positions in forest products industries and in the Forest Service. Summer is the major season for most forestry operations and positions may be available for a limited number of high school students in the Youth Conservation Corps or in Project ReLeaf in state and national parks. Positions may also be available in nurseries and on tree farms.

Requires a high school education or two year associate degree.

Courtesy USDA, Forest Service.

- **High school education**—Enables you to learn basic skills on the job; many entry-level positions involve manual or clerical work with opportunities for advancement to foreman and supervisor as you learn more skills.

Courtesy USDA, Forest Service.

EXAMPLE:
— Operate equipment such as trucks, dozers and other heavy machinery

— Handle raw timber and cut lumber or other forest products in a lumber yard

— Manufacture a wide variety of forest-related products

— Work as a forestry aide—keep public recreation areas and facilities clean, cut wood, prune Christmas trees, plant trees and seedlings, assist forestry technicians, clear brush and fire breaks, maintain road signs and do a wide variety of other tasks

NOTE: Entry-level nonprofessional jobs generally pay hourly wages. The more dangerous jobs tend to pay more than those with fewer risks.

- **Two-year associate degree**—Emphasizes the practical aspects of forestry and teaches students the skills to perform forestry field work. Technicians are required to direct and supervise forestry aides and laborers.

Courtesy USDA, Forestry Service.

EXAMPLES:
— Survey property
— Supervise planting crews
— Cruise, mark, scale, appraise and measure logs and trees
— Oversee timber sales and silvicultural practices
— Work in fire detection and fire control
— Gather research data from experimental plots, watershed or other forestry operations

NOTE: A high-school diploma with courses in science, math, communications, and particularly in computers will give a student an advantage for studying forestry in college. See NOTE for Level 2.

LEVEL 2—Professional forester

- **Four-year college degree**—Is a professional training program that prepares men and women for a career in a forestry-related field.

  EXAMPLES:
  - Management of timber crops
  - Work in forest products industries
  - Forest management
  - Environmental protection and research
  - Wildlife management
  - Forest engineering
  - Public relations and education
  - Computerized site analysis
  - Utility forestry
  - Urban forestry
  - Wood utilization
  - Administration
  - Forest fire management

  NOTE: Some states require experience plus a degree for registration as a professional forester. For a list of accredited professional forestry and recognized forest technical educational programs in the United States, write to Associate Director, Education & Professional Standards, Society of American Foresters, 5400 Grosvenor Lane, Bethesda, MD 20814.

LEVEL 3—Specialist

- **Advanced college degrees**—Enable a professional forester to become a teacher, a researcher or other specialist.

  EXAMPLES:
  - Hydrology
  - Genetics
  - Ecology
  - Plant pathology
  - Chemical research in growth stimulants, retardants, insect and disease control
  - Wood technology
  - University teaching

OBJECTIVE 5

Select from a list personal requirements for a career in forestry.

- Enjoys outdoor work
- Enjoys working with people
- Can work long hours at a desk reading and writing reports, keeping records, planning and designing
- Is interested in trees, plants and animals
- Is interested in science and enjoys studying science
- Enjoys measurements and math
- Is able to work without direct supervision

  NOTE: A professional forester may be the only one in an area or in a certain district. Forest technicians and aides often work in pairs or alone. Technicians must be able to carry out instructions and collect measurements or research data thoroughly and correctly without supervision.

- Has a desire to contribute to the broad issues of our world ecology

- Can use short-term results to establish long-term goals

  NOTE: Areas of immediate goals are fire fighting, measurements, and forest products. A forester can have the satisfaction of setting and meeting intermediate goals in areas such as regeneration, yearly crops, nurseries, and seedling farms.

- Likes helping others

Courtesy of USDA, Forest Service.

- Has good communication skills

  EXAMPLE: Talking with people, making people feel comfortable, writing reports and speaking in public

- Knows and follows safety procedures
- Can adapt to new situations

OBJECTIVE 6

List advantages and disadvantages of a forestry career.
(Supplement 1, Activity Sheet 1)

Advantages

- **Good working conditions**—Working conditions are usually pleasant, most people in the profession like their work and are easy to get along with.

- **Reasonable pay**—Pay scales are comparable to other public service careers, and salaries increase with experience.

  NOTE: See Activity Sheet 1 and Supplement 1.

- **Longevity**—Barring accidents, most people can count on a lifetime career as a professional forester.

- **Service to others**—All forestry activities benefit individuals, society, and environment and ecology.

- **Job opportunity**—There are over 700 job categories and more than 14,000 employers hiring forestry professionals and nonprofessionals.

  NOTE: These statistics come from the Society of American Foresters and represent only members of the association. There are employers who are not members and areas of employment that are not included in these figures, so the actual range of opportunity is even larger than the statistics show.

- **Variety of experience**—Foresters deal with new people and solve new problems every week; in many forestry careers, work changes with the seasons, with the weather or with current economic values.

Disadvantages

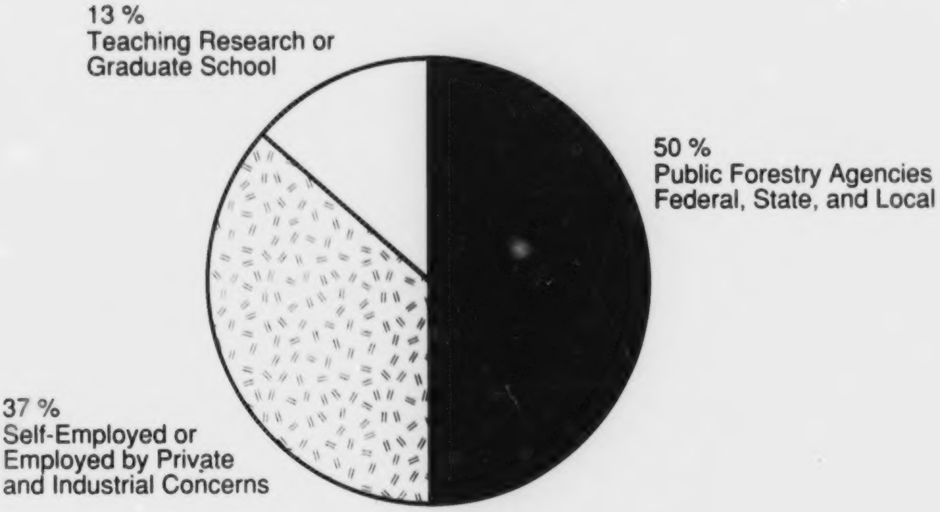
- **Isolation**—Many job locations are in rural areas, small towns without many cultural activities or job opportunities for spouses. This situation can put a strain on family life, especially for foresters and spouses who have grown up in cities.

- **Dangerous job**—Logging and fire fighting are two of the most dangerous job categories according to U.S. Safety statistics. Foresters and technicians are usually involved in both logging and fire fighting.

  NOTE: Quality safety training is available. There are always risks involved in forestry operations, but hazards can be minimized by good safety practices.

OBJECTIVE 7 **Match organizations that employ people trained in forestry to their descriptions.**
(Assignment Sheet 1, Supplements 5 and 6)

NOTE: The Society of American Foresters lists nearly 14,000 separate employers among its members. See Supplement 5 with stories about people working in forestry.



- **Federal agencies**—Manage the resources of Federal lands including water, timber, forage, wildlife and recreational opportunities. Federal agencies employ thousands of professional foresters, forestry workers and people in related fields; salary is based on U. S. Civil Service Commission ratings.

  NOTE: Most positions in federal agencies are under the U.S. Civil Service Commission and salaries are determined by GS (Government Service) ratings of 1-15.

  EXAMPLES: U.S. Department of Agriculture
  Peace Corps
  National Park Service
  Bureau of Land Management
  Bureau of Indian Affairs
  Bureau of Outdoor Recreation
  Department of Commerce
  Department of Defense
  Internal Revenue Service

  NOTE: See Helen's story in Supplement 5.

- **State Agencies—Offer technical assistance to timberland owners and forest products manufacturers; involved in production, research, education, fire suppression, and enforcing state laws related to fire and forest protection.**

  State agencies are involved in many aspects of forestry. Some of the responsibilities are: operate tree seedling nurseries, seed orchards and seed production areas; provide leadership in insect and disease control; provide public education on forest resources and forest fire prevention; conduct research in tree improvement, wood utilization, and forest pests; inventory forest and timber production and use; and detect and suppress wildfires.

  State agencies employ professional foresters and forestry workers. Income is based on state civil service ratings in most cases.

  NOTE: Local agencies also hire people trained in forestry. For example, cities and counties hire foresters for planning, urban forestry, recreation management and watershed projects. See Joe's story in Supplement 5.

  EXAMPLES: Oklahoma Department of Agriculture, Forestry Division; Texas Forest Service; Department of Forestry, State of Oregon; Cooperative Extension Services; State Conservation Commission

  NOTE: See Carl's story in Supplement 5.

- **Forest products industries**—Manufacture lumber and wood products, furniture and fixtures, and paper and pulp products. Forest products industries employ professional foresters, a large number of forestry workers and related skilled and unskilled labor. Income is based on salary or hourly wage, and some positions earn sales commissions.

- **Tree farms and nurseries**—Private forestry operations that are involved in the production of trees. They employ professional foresters or consultants as managers, and employ many nonprofessional and nontechnical workers. Income is based on salary or hourly wage.

  NOTE: See Gene's story in Supplement 5.

- **Public and private institutions and agencies**—Involved in a wide variety of forestry activities including teaching, extension, research, administration, design and analysis, and public relations and information.

  Universities and professional associations employ professionals for many different positions relating to forestry. Income is usually salaried and depends on education, experience and the level of responsibility.

  EXAMPLES: U.S. Department of the Interior, NASA, Southern Forest Institute, Society of American Foresters, National Forest Products Association, Southern Forest Products Association

  NOTE: See Miguel's and Carol's stories in Supplement 5.

- **Forestry consultant**—Manage privately-owned forest land, may direct or advise on logging operations and timber sales. Forestry consultants are self-employed, and income is based on fees and commissions.

  NOTE: See Steve's story in Supplement 5.

OBJECTIVE 8 **Identify the communication skills required in given situations.** (Assignment Sheets 2, 3, and 4)

Speech communication

Interpersonal communication is a broad category of communication behaviors and skills that includes one-on-one communication, group processes, persuasion, and public speaking.

NOTE: One-on-one communication includes self-perception, good listening skills, dealing with defensive or aggressive communication from others, interpreting nonverbal signals, getting rid of unwanted signals in order to convey what you mean; essential for supervisors and managers.

- **Group processes or small-group**—Working effectively and cooperatively with others in decision-making and policy-making committees, in offices, and in the field.
- **Public speaking**—One person addressing a group to inform, persuade, move to action, or to entertain; basic for all areas of forestry work above forestry worker or aide.

  NOTE: Persuasion is using information, statistics, examples, emotionally-charged stories, and other means to advocate an idea or position so that people will agree with you; essential for policy-making and public relations work; can be used in all communications situations. Persuasion is the skill used in debate, law, and advertising. It often means disproving the opposition as well as advocating your own position.

- **Systems communication**—How to route information effectively through an organization; essential for crisis operations such as fire fighting and for large, multilevel organizations such as government and major industrial producers.

  NOTE: Systems communication is a specialized area of communications and requires a four-year college education. The other skills can be learned in some high school courses and in most two-year college programs.

Written communications

- **Technical writing**—A broad category of writing intended to communicate information for a specific purpose; used for reports, manuals, instructions, scripts for non-fiction videotapes and films; includes the creation and use of charts, graphs, tables, and illustrations as well as writing skills.

- **Business correspondence**—Clear, brief interpersonal communication that follows a standard format; used to exchange information, to make requests, to record orders and sales, to make and handle complaints, etc.; serves as a legal record of interactions.

  EXAMPLE: Business letters

- **Report writing**—Describes past, current or projected future situations; often uses statistics and research data to explain the situation

  EXAMPLES: —*Meeting the Challenge: A Progress Report on Pollution Control by the Northwest Pulp and Paper Industry*
  —*Twenty-year Results of a Shortleaf Pine Seed Source Study in Oklahoma*
  —*The Effects of Logging on Fish of the Western United States and Canada*

FORESTER'S SALARIES BY STATE

	Alabama	Alaska	Arizona	Arkansas	California	Colorado	Connecticut
Governor's Salary	70,200	81,600	NOT AVAILABLE	35,000	85,000	70,000	78,000
State Forester's Salary	75,000	64,600		51,000	91,000	59,400	65,000
Regional Forester's Salary	47,900	54,900		30,000	71,000	42,200	46,000
District Forester's Salary	42,200	44,500		25,000	62,000	29,000	43,000
Service Forester's Salary	27,200	38,600		20,000	53,000	24,700	38,000
Entry-Level Forester's Salary	19,600	32,400		16,000	48,000	20,500	30,000
Forestry Technician's Salary	21,500	(6 months) 13,700		18,000	31,000	--	28,000

	Delaware	Florida	Georgia	Guam	Hawaii	Idaho	Illinois
Governor's Salary	70,000	96,900	--	60,000	91,000	NOT AVAILABLE	95,000
State Forester's Salary	41,000	56,650	75,000	44,533	51,000		50,000
Regional Forester's Salary	33,000	43,164	52,000	--	37,000		30,000
District Forester's Salary	29,000	35,945	40,000	--	48,000		28,000
Service Forester's Salary	23,300	24,000	31,000	30,684	31,000		--
Entry-Level Forester's Salary	22,400	18,313	26,000	21,002	18,000		22,000
Forestry Technician's Salary	13,600	17,190	24,000	--	19,000		23,000

	Indiana	Iowa	Kansas	Kentucky	Lousiana	Maine	Maryland
Governor's Salary	77,200	72,500	70,000	55,000	73,440	73,000	90,000
State Forester's Salary	54,002	54,000	51,000	45,900	48,834	43,000	49,814
Regional Forester's Salary	37,000	41,000	44,000	48,200	35,752	40,000	38,727
District Forester's Salary	--	--	--	36,200	33,851	30,000	39,544
Service Forester's Salary	32,900	32,000	29,000	22,300	27,633	28,000	27,262
Entry-Level Forester's Salary	21,606	22,000	21,500	16,600	19,865	22,000	17,261
Forestry Technician's Salary	--	19,000	22,000	16,800	19,016	19,000	21,325

	Massachusetts	Michigan	Minnesota	Mississippi	Missouri	Montana	Nebraska
Governor's Salary	NOT AVAILABLE	105,900	103,900	63,000	85,000	51,200	58,000
State Forester's Salary		68,500	62,700	56,600	50,000	41,500	89,500
Regional Forester's Salary		51,000	45,000	37,200	42,000	33,500	42,500
District Forester's Salary		48,400	40,000	34,200	35,000	28,000	34,350
Service Forester's Salary		31,400	30,000	22,000	27,000	21,800	25,375
Entry-Level Forester's Salary		22,800	22,500	19,000	18,000	18,600	23,000
Forestry Technician's Salary		26,500	20,000	16,500	16,680	19,000	20,000

	Nevada	New Hampshire	New Jersey	New Mexico	New York	North Carolina	North Dakota
Governor's Salary	77,500	73,000	85,000	63,000	130,000	116,316	67,000
State Forester's Salary	53,000	53,000	64,000	50,000	91,000	56,000	47,000
Regional Forester's Salary	35,000	36,000	53,000	30,200	51,500	40,000	28,000
District Forester's Salary	38,000	31,000	43,000	26,200	43,700	34,000	24,000
Service Forester's Salary	32,500	29,000	35,000	21,800	35,000	28,000	--
Entry-Level Forester's Salary	21,000	23,000	23,000	15,600	23,100	20,000	21,000
Forestry Technician's Salary	25,000	19,000	22,000	15,800	24,500	21,000	18,000

	Ohio	Oklahoma	Oregon	Pennsylvania	Puerto Rico	Rhode Island	South Carolina
Governor's Salary	100,000	70,000	75,000	85,000	NOT AVAILABLE	70,000	91,600
State Forester's Salary	55,058	41,200	62,700	60,000		49,000	65,300
Regional Forester's Salary	45,400	31,600	49,942	36,000		32,800	44,400
District Forester's Salary	37,400	23,600	39,116	43,000		28,000	34,000
Service Forester's Salary	31,200	20,400	27,767	29,000		22,800	31,800
Entry-Level Forester's Salary	20,000	19,400	22,296	22,000		19,900	20,000
Forestry Technician's Salary	24,000	18,900	18,358	18,000		20,000	22,500

	South Dakota	Tennessee	Texas	Utah	Vermont	Virgin Islands	Virginia
Governor's Salary	60,819	65,000	91,600	70,000	--	NOT AVAILABLE	100,000
State Forester's Salary	36,078	65,500	91,500	43,000	45,000		65,100
Regional Forester's Salary	31,861	35,400	47,100	30,000	42,000		38,100
District Forester's Salary	25,165	36,700	31,900	31,000	35,000		29,200
Service Forester's Salary	20,322	31,000	31,900	24,000	28,000		26,700
Entry-Level Forester's Salary	17,784	29,777	18,900	17,800	25,000		24,400
Forestry Technician's Salary	13,525	25,000	18,900	14,700	26,000		22,300

	Washington	West Virginia	Wisconsin	Wyoming			
Governor's Salary	99,600	72,000	NOT AVAILABLE	70,000			
State Forester's Salary	79,200	37,224		45,200			
Regional Forester's Salary	43,600	29,712		31,600			
District Forester's Salary	35,500	30,744		31,600			
Service Forester's Salary	27,400	19,321		20,850			
Entry-Level Forester's Salary	26,000	15,900		20,850			
Forestry Technician's Salary	22,100	18,432		22,400			

Source: National Association of State Foresters, 1990 Report, State Forestry Statistics Committee.

EXAMPLES OF JOBS IN THE FOREST PRODUCTS INDUSTRY THAT DO NOT REQUIRE A 4-YEAR DEGREE

- **Nursery worker**—Works or manages a nursery where young trees are grown
- **Timber producer**—Operates or manages a timber harvesting crew; owns timber-harvesting equipment, and sells timber to sawmills or pulpwood dealers
- **Timber cruiser**—Surveys forest land to locate timber and estimate the amount of wood

  NOTE: The cruiser estimates according to species, products, size, quality, value, etc.
- **Timber buyer**—Purchases timber
- **Pulpwood dealer**—Buys wood from the producer and resells it to the mill
- **Logging contractor or subcontractor**—Performs harvest operations
- **Woods supervisor**—Oversees the total logging operation
- **Timber marker**—Selects and marks the trees to be harvested in a cutting operation
- **Timber cutter**—Fells, bucks, limbs, and tops trees
- **Logging operator**—Owns or manages a logging operation
- **Logger**—Works at harvesting logs or pulpwood
- **Heavy equipment operators**—Operates and maintains dozers, skidders, loaders and other machinery
- **Choker setter**—Attaches chain hooks or collar and chain to harvested timber so logs can be hauled out of the harvest area by a skidder
- **Truck drivers**—Operate log-hauling equipment, haul pulpwood, timber, or manufactured wood products

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- **Sawmill manager**—Hires, plans and makes decisions about how to operate a sawmill
- **Sawmill equipment operator**—Operates and maintains equipment for handling, cutting, and storing lumber
- **Millwright**—Installs and maintains machinery
- **Machinery and equipment repairman**—Keeps diesel, gasoline, or electrical equipment running in logging or mill operations
- **Scaler**—Measures timber to determine the volume of pulpwood and/or logs and estimates value
- **Grader**—Inspects and grades milled or rough-sawed lumber according to specifications
- **Lumber checker**—Inspects lumber after grading
- **Pole inspector**—Inspects and grades poles and pilings
- **Pulpwood yard manager**—Manages receipt, storage and shipping of wood
- **Pulpwood yard supervisor**—Supervises the total woodyard operation
- **Pole yard manager**—Supervises a pole treating plant
- **Sales and service managers**—Sells and supervises service of all types of forestry equipment and machinery

U.S. FOREST SERVICE POSITIONS

NOTE: Send for your own copy of *A Job With the Forest Service: A Guide to Career Opportunities in Technical Support Positions.* Miscellaneous Publication No. 1395, United States Department of Agriculture, 1981. In addition to describing these positions, it explains GS ratings and requirements for nonprofessional employment with the Forest Service. It also lists schools that have technical training programs and national forests, research headquarters, and Federal Job Information Centers where you might be able to find a summer job in a forestry-related field. The pamphlet can be ordered from the U.S. Government Printing Office, Washington, D.C. 20240. The information below comes from this pamphlet.

- **Forestry Aides and Technicians**—Perform a variety of duties; collect and record tree measurements, record data from research stations and equipment, thin young timber stands to increase productivity, maintain public campgrounds, serve on fire fighting crews.

- **Hydrologic Aides and Technicians**—Collect, select, compute, adjust and process data; prepare charts and reports; and perform related duties supporting professional work in hydrology.

- **Physical Science Aides and Technicians**—Assist professional employees by performing duties such as calibrating and operating measuring instruments, mixing solutions, making chemical analyses, setting up and operating test apparatuses, and compiling and processing scientific data.

- **Biological Aides and Technicians**—Work in biological and agricultural laboratories and field or experimental areas such as greenhouses, growth houses, hatcheries, and wildlife refuges. Provide technical support and assistance to professional personnel engaged in scientific and technical work.

- **Engineering Aides and Technicians**—Assist in the survey, design, and construction of forest roads, trails, recreation areas, bridges, and buildings. Requires knowledge of transit, level, and staff compass techniques; survey methods and procedures; notekeeping and safety practices.

- **Surveying Aides and Technicians**—Serve as members of crews doing such jobs as route survey work, construction staking, chaining, clearing lines, notekeeping, and other work involved in preliminary surveying. They may also serve as firefighters during periods of high fire danger.

- **Range Aides and Technicians**—Perform various tasks in connection with the management, conservation, development, utilization, and protection of forage and related range resources for livestock or big game.

- **Trade and Craft Workers**—Carpenters, parachute repairers and packers, welders, cooks, bulldozer operators, and others experienced in specific trades and crafts are employed for construction, maintenance, fire control, and other projects.

- **Forest Workers/Laborers**—Assigned duties such as eliminating undesirable trees, pruning trees, building firelines, planting seedlings, digging ditches, and loading and unloading equipment and tools.

- **Clerical Personnel**—Involved in a variety of tasks such as typing, filing, telephone and receptionist duties. The clerical staff provides assistance in all clerical-related functions in support of the agency mission.

WHAT YOU NEED TO SUCCEED

- **Forestry Aide**

  Show a desire to learn, have an ability with tools, and be in good physical condition that will allow prolonged standing, walking over uneven ground, bending, reaching, digging, lifting and carrying items weighing about 50 pounds. High school courses should include agriculture, horticulture or forestry, and basic math courses. Look clean, be well-organized, and speak clearly and confidently. Be a hard worker, dependable, and follow instructions.

- **Forestry Technician**

  Earn an Associate degree in Forestry. Take math, biology, earth sciences, writing and public speaking courses in high school. Be physically fit to work outdoors in rough terrain and develop leadership skills to direct and supervise others. Develop a wide knowledge and wide variety of forestry skills. You can learn some of the basic hands-on skills a forester needs in agriculture and horticulture courses. Maintain high standards for your work. Be dependable, communicate clearly, be fair.

- **Professional Forester**

  Take all the math, chemistry, biology, physics, earth sciences and natural resources courses you can get at your school. Take communication courses such as public speaking and debate and learn to write well in courses such as journalism or technical writing. Photography is also a skill some foresters will use throughout their careers.

  Learn skills in critical thinking, analysis and problem solving. Learn to be patient and to work well with people. Learn to see the broader picture and to communicate your understanding to others.

MEET PEOPLE WHO WORK IN FORESTRY

- **Helen - Federal agencies**

  Helen is a distict ranger on a National Forest in the Pacific Northwest. She is the manager of a district covering over 200 square miles of both forests and grasslands. As such, Helen has the responsibility for management of these lands to assure wildlife habitat, sustained timber yields, forage production, watershed values, and recreational opportunities for over 1 million forest visitors each year. In her job as a forester, Helen must be highly skilled not only in vegetation management, but in planning, budgeting, personnel management, and public relations. She oversees five foresters, four forest technicians, and 25 other employees.

- **Carl - State agencies**

  Carl is a forestry technician for a state forestry department. After completing a two-year forestry program in his home state, he served two years in the Peace Corps. He is now responsible for vegetation management in four high-use recreation areas on state forest lands. He develops work schedules and supervises planting, pruning, fertilizing and other maintenance of trees, shrubs, and other vegetation. Carl has just completed a two-day refresher course in tree fertilization.

- **Jim - Forest products industries**

  Jim is a unit manager for a major pulp and paper company in the Southeast. He is responsible for all forest management activities on 30,000 acres of company-owned and leased lands. Six years out of college, he has been promoted to this position after various job assignments involving forest inventory, harvesting, and regeneration. He has surveyed forest boundaries, estimated timber volumes, marked trees for harvest, supervised planting crews, fought fires, and checked permits giving access to company lands during hunting season. He now supervises all of these activities, administers timber sales contracts, negotiates leases, and prepares operating plans and budgets.

- **Gene - Tree farms and nurseries**

  Gene works for a tree seedling nursery in the Lake States. He earned an Associate degree in forestry four years ago and is now responsible for supervising seed collection, seeding and management of nursery beds, and lifting (digging) seedlings.

- **Miguel - Public and private institutions and agencies**

  Miguel is a forest geneticist. He has a Ph.D. and is working at a major university. Involved in both teaching and research, he is leading a long-term project in tree improvement—selecting, testing, and developing new trees for better quality, faster growth, and resistance to insects and disease. Miguel's area of research is a primary key to assuring an adequate supply of forest products in the future.

- **Carol - Public agencies**

  Carol is employed by the National Air and Space Administration. With a degree in forestry and specialized training in cartography (map making), she is responsible for analyzing satellite photographs. She has recently developed a computer program to forecast the reactions of sub-arctic vegetation to predicted ozone layer changes

- **Steve - Self-employment as a forestry consultant**

  Steve is a consulting forester in New England. He provides specialized services to private forest land owners. His clients are farmers, professional people, and small forest-product companies. Steve has built his business over the past nine years, and is involved daily in activities such as preparing woodlot management plans, administering timber sales, evaluating insect and storm damage, and meeting with clients. Steve holds a real estate appraiser's license in his home state. He has also become an expert in forest taxation.

Reprinted from "So You Want to Be In Forestry," published by the Society of American Foresters, 5400 Grosvenor Lane, Bethesda, MD 20814-2198.

RESOURCES

Guidelines for Obtaining Information

- Try contacting local sources first by telephone. They often have the same or similar information that is distributed by national agencies.
- Allow 2-4 weeks for a response.
- State what you want specifically—what materials you need, what questions you want answered, what issues you are studying.
- Request only what you need.
- Enclose a stamped, self-addressed envelope.

Addresses for Requesting Information and Materials

Your teacher will supply information about resources in your state.

AMERICAN FORESTRY ASSOCIATION, P.O. Box 2000, Washington, D.C., 20013 or 1516 P. Street Washington, D.C. 20005. Publishes *American Forests.*

FOREST HISTORY SOCIETY, INC., 701 Vickers Avenue, Durham, NC 27701. Publishes *Journal of Forest History.*

IZAAK WALTON LEAGUE OF AMERICA, INC., 1701 N. Fort Meyer Drive, Suite 1100, Arlington, VA 22209. Publishes *Outdoor America* and *Save Our Streams.*

NATIONAL ARBOR DAY FOUNDATION, 100 Arbor Avenue, Nebraska City, NE 68410. Publishes *Arbor Day.*

NATIONAL PARKS AND CONSERVATION ASSOCIATION, 1015 31st Street, NW, Washington, DC 20007. Publishes *National Parks Magazine.*

NATIONAL WILDLIFE FEDERATION, 1412-16th Street, NW, Washington DC 20036. Publishes *National Wildlife, Ranger Rick, Your Big Backyard, NatureScope, International Wildlife,* and *Conservation Directory.*

SOIL CONSERVATION SOCIETY OF AMERICA, 7515 NE Ankeny Road, Ankeny, IA 50021. Publishes the *Journal of Soil and Water Conservation.*

WESTERN FORESTRY AND CONSERVATION ASSOCIATION, 4033 SW Canyon Road, Portland, OR 97221.

FOREST SERVICE — USDA
P.O. Box 96090
Washington, D.C. 20090-6090

UNITED STATES DEPARTMENT OF AGRICULTURE-SOIL CONSERVATION SERVICE, P.O. Box 2890, Washington, DC 20013.

UNITED STATES FISH AND WILDLIFE SERVICE, DEPARTMENT OF THE INTERIOR, Washington, DC 20240, Attention Publications Unit.

AMERICAN FOREST COUNCIL, 1250 Connecticut Avenue, NW, Washington, DC 20036.

AMERICAN PAPER INSTITUTE, 260 Madison Avenue, New York, NY 10016.

AMERICAN PLYWOOD ASSOCIATION, Box 11700, Tacoma, WA 98411.

AMERICAN PULPWOOD ASSOCIATION, 1025 Vermont Avenue, NW, #1020, Washington, DC 20005.

AMERICAN WOOD COUNCIL, 1250 Connecticut Avenue, NW, Washington, DC 20036

NATIONAL FOREST PRODUCTS ASSOCIATION, 1250 Connecticut Avenue, NW, Washington, DC 20036.

WESTERN WOOD PRODUCTS ASSOCIATION, 1500 Yeon Building, Portland, OR 97204.

SOCIETY OF AMERICAN FORESTERS, 5400 Grosvenor Lane, Bethesda, MD 20814. Publishes the *Journal of Forestry.*

WESTERN REGIONAL ENVIRONMENTAL EDUCATION COUNCIL, State Department of Education, 721 Capitol Mall, Sacramento, CA 95814.

SAMPLE SPEECH OUTLINE

Topic: How to fill out a job application form.

Think how choppy and boring a speech would be if you read it. **Talk with the audience** as you would with a small group of friends, explaining and giving examples as you cover each idea.

I. What to expect on the form

  A. 1-3 pages long
  B. Questions about education, experience, references, military service, personal goals, minority questions

II. What information you'll need

  A. Education
    1. What schools you went to and when
    2. Give examples
  B. Work history
    1. What jobs, for whom and when
    2. Give examples
  C. Names, addresses and phone numbers of references
  D. Perhaps high school records

III. How to fill in the form correctly

  A. Provide all the information asked for
    1. Write N/A for "not applicable" where needed
  B. Print neatly or type - Neatness is very important
    1. Legible
    2. First impression the employer has of you
  C. Tell the truth—Explain why lying is a bad policy
    1. It can catch up with you later and ruin your employer's faith in you
    2. Your history, records, references and the application should match up
  D. List all experiences, abilities and skills related to the job you are applying for

  Examples: General business and math courses, FFA, president of my church youth league, helping my dad on the farm, cutting firewood, planting crops, operating tractors, pumps and other equipment

ACTIVITY SHEET 1 | **INVESTIGATE FORESTRY CAREER OPPORTUNITIES** | **II**

COMPARE FORESTRY SALARIES

PART 1

Compare your state's foresters' salaries with two surrounding states.

Write in the names of the states.

Career Position	Your State	____________ State #1	____________ State #2
Technician			
Entry-level			
Service Forester			
District Forester			
State Forester			

PART 2

Interview your parents, a neighbor, another member of your family, or check with your school career counselor and find out about the pay scale in another career.

Career field ________________________

	With no degree	With a college degree
Entry-level	$ ______________	$ ______________
Salary after 5 years	$ ______________	$ ______________
Salary after 10 years	$ ______________	$ ______________
Salary after 15 years	$ ______________	$ ______________

ASSIGNMENT SHEET 1

INVESTIGATE FORESTRY CAREER OPPORTUNITIES

II

NAME ____________________ SCORE ________

OBJECTIVE 9 **Identify state and local employment opportunities**

INTRODUCTION Where can a person who wants to work in forestry find jobs in your area and in your state? Learning how to identify resources is the first step in getting a job.

DIRECTIONS Complete this assignment sheet as a class project. Write the name of the person who will complete the task in the first blank. When the task is completed write the date in the second blank.

Supplement 5 may help you locate resources.

Task	Name	Task Completed
1. Contact the state forestry department and request a list of state forests and state forestry operations and research stations, find out how many forestry extension agents work in your state, and request a list of private forestry operations in the state.	____________	________
2. Identify national forests and parks in your state.	____________	________
3. Contact the state wildlife department and request a list of state wildlife reserves, state parks or other agencies that hire forestry-related employees.	____________	________
4. Identify local and area forest products companies.	____________	________
5. Contact a local forest products company and find out how many people it employs and what positions it has for nonprofessional and professional people and for unskilled labor.	____________	________
6. Look up forest products manufacturers in your state's *Census of Manufacturers* in your public library.	____________	________
7. Locate local and area nurseries.	____________	________

Task	Name	Task Completed
8. Identify college and university forestry programs in your state.		
9. Identify cities that hire park and recreation forestry employees.		
10. Identify the major utilities companies in your state.		
11. Check the yellow pages in local and area directories for tree maintenance companies.		
12. Check the yellow pages in local and area directories for forestry consultants.		
13. Keep a record of the information received for this project.		
14. Collect and put together the information gathered.		
15. Make a wall chart map displaying job opportunities in the state.		
16. Give an oral report to the class on your findings.		
17. Write an article for the school and/or local newspaper.		
18. Photograph the map to be used in the article.		

ASSIGNMENT SHEET 2

INVESTIGATE FORESTRY CAREER OPPORTUNITIES

II

NAME ______________________________ SCORE _______

OBJECTIVE 10

Write a thank-you letter.

INTRODUCTION

Thank-you letters should follow written requests, personal interviews and job interviews. They not only convey your appreciation for the time spent with you, but they also indicate that you are interested in the person or the position. Since written communications are important to all business interactions, you should know the proper form and style.

A thank-you letter should include:

- Return address—your name and address on the left or right side
- Date on the left side
- Inside address—the person's name and address
- Salutation or greeting followed by a comma if hand-written, or a colon if typed—Dear ....:
- The body of the letter:
  - Thank the person, stating the date and purpose
  - Mention a positive aspect of the exchange
  - Tell how his or her cooperation helped you
  - End with a note of positive feeling
- Closing—Sincerely, Yours truly, etc.
- Signature, or if typed, signature space and typed name underneath.

Be sure your spelling and grammar are perfect. If you're not sure, have someone proofread the letter before you mail it.

DIRECTIONS

1. Use the example on the next page as a model.
2. Write a thank-you letter to one of the people you interviewed in person or on the phone or to someone who sent you information for your project. If you did not get help, make up a reason and write a letter to demonstrate that you can do it.
3. Give your letter to your teacher for evaluation before you mail it.

J. C. Student
Rt. 1, Box 111
Forestville, OK 71111
(405) 555-1111

October 11, 1991

Mr. Howard Helpful
1111 Patootie Road
Forestville, OK 71111

Dear Mr. Helpful:

Thank you for taking the time to talk to me about forest-fire fighting equipment last Tuesday, October 7. It was a pleasure to meet you and to learn more about fire fighting techniques.

I was especially interested in the computer programs available for predicting fire behavior. I hope to learn more about it someday.

When I made my report to the class, they were surprised to learn how important radios, computers, radar and other equipment are to fight forest fires. My teacher, Mr. Jones, was impressed and gave me an A.

I hope to have the pleasure of visiting with you again.

Sincerely,

J. C. Student

ASSIGNMENT SHEET 3 — INVESTIGATE FORESTRY CAREER OPPORTUNITIES — II

NAME ______________________________ SCORE ________

OBJECTIVE 11

Outline a presentation on forestry careers.

INTRODUCTION

The ability to research information and put ideas together is important in forestry. Foresters often have to present reports on different aspects of their field.

DIRECTIONS

In this assignment sheet you will be outlining a presentation. In Assignment Sheet 4 you will give the presentation to the class.

Allow three weeks to select a topic, gather information and prepare your presentation.

PART I

Decide on a topic and clear it with your instructor before you begin putting your speech together.

Topic ____

Why is this topic interesting to you? ______________________

____

____

Why would it be interesting to your audience? ______________

____

____

What resources will you use to get information? (who will you talk to, what will you read?) ______________________

____

____

____

____

PART II

NAME________________________________

Speech Title (try for a catchy title)____________________________

Introduction

Attention getter ____

____

____

____

How I will relate my topic to this audience____________________

____

____

____

Statement of the topic ______________________________________

____

____

____

Body

See Sample Outline in Supplement 7.

The main points are Roman numerals I, II, III. The subpoints are letters A, B, C and examples and explanations are Arabic numerals 1, 2, 3. You should have **no more than** one major point in a 2-minute speech; 2 major points in a 3 minute speech, 3 major points in a 4-minute speech, etc.

Include your examples and explanations. Write transitions in the margins between Roman numerals

Summary

List major points

____

____

____

____

Conclusion

How will you conclude the speech so that the audience knows the speech is finished?

____

____

____

Timing

Time the speech, using the outline to make a rough practice speech at home. Do it three times and calculate the average length.

Time ____________________________

What can you do to help you stay within the time limit? If you need help, ask your instructor.

____

____

____

Show this sheet to your instructor for helpful guidance.

ASSIGNMENT SHEET 4 — INVESTIGATE FORESTRY CAREER OPPORTUNITIES

NAME ______________________________ SCORE ________

OBJECTIVE 12 **Give a presentation about a career in forestry.**

INTRODUCTION A major part of every forester's job is to work with people, to inform the public about forestry and to help build awareness and understanding of forestry problems and concerns. Developing the confidence and skill to speak in front of a group will help you in any career.

DIRECTIONS Prepare a 3-5 minute presentation or report on some aspect of forestry careers that interests you. Your instructor will schedule a time for you to give the presentation to the class.

ASSIGNMENT ANSWERS

INVESTIGATE FORESTRY CAREER OPPORTUNITIES

II

ASSIGNMENT SHEET 1

Check that each student has completed the assignment listed.

ASSIGNMENT SHEET 2

Check that the letter includes:

- Return address—sender's name and address on the left or right side
- Date on the left side
- Inside address—the receiver's name and address
- Salutation or greeting with a comma after salutation if hand-written or a colon, if typed
- The body of the letter:

  Thank the person, stating the date and purpose

  Mention a positive aspect of the exchange

  Tell how his or her cooperation helped you

  End with a note of positive feeling
- Closing—Sincerely, Yours truly, etc.
- Signature if hand-written or if typed, signature space and typed name underneath
- Correct spelling
- Correct grammar
- Neatness

ASSIGNMENT SHEET 3

Check for appropriate topic and a logical order of ideas. Make suggestions to improve the presentation.

ASSIGNMENT SHEET 4

Evaluated according to the criteria on Teacher Supplement 3 - Speech Evaluation Sheet

WRITTEN TEST

INVESTIGATE FORESTRY CAREER OPPORTUNITIES II

NAME ______________________________ SCORE _______

OBJECTIVE 1

Match terms associated with forestry careers to their correct definitions. Write the correct letters in the blanks.

____ 1. A professional forester whose services are available to the general public on a contract or fee basis, with the fee paid by the the client

____ 2. All the aspects related to beautifying or improving the appearance of a particular environment

____ 3. The removal of an entire standing crop of trees

____ 4. To estimate the volume of standing timber

____ 5. The scientific study of the relationships of living things to one another and to their environment

____ 6. To speak or write in support of something

____ 7. Between or among people

____ 8. The total of all surrounding things, conditions, or influences, especially as they affect the existence or development of nature and of people

____ 9. Plant material of any kind available for animals to eat

____ 10. Determining how many, where, how, and if trees should be harvested to meet economic, environmental, and aesthetic goals

____ 11. Trying to get legislators to vote for measures favorable to a special interest, such as forestry

____ 12. Mechanically ground or chemically digested wood used to make wood products

a. Advocate
b. Aesthetic
c. Agronomy
d. Clearcutting
e. Communal
f. Consultant
g. Cruise
h. Ecology
i. Economics
j. Environment
k. Estimation
l. Forestry technician
m. Forage
n. Interpersonal
o. Inventory
p. Lobbying
q. Persuasion
r. Pulp

___13. Estimating the economic worth of timber and determining ways to increase, manage and protect the worth of timber and forest products

___14. The renewal of a tree crop by natural or artificial means

___15. The procedures used to extinguish a forest or grass fire

___16. On a job application form, the names, addresses, and phone numbers of people who can tell an employer about your work abilities and character

___17. Referring to cities

___18. A drainage system; the area from which all the run-off flows into a particular stream

s. References
t. Regeneration
u. Repression
v. Replanting
w. Runoff slope
x. Slash wood
y. Suburban
z. Suppression
aa. Urban
bb. Valuation
cc. Watershed

OBJECTIVE 2

Select from a list true statements about the forestry profession. Write an "X" in the blank before each correct answer.

____ 1. Forestry works on a grand time scale, planning for 15-50 years into the future.

____ 2. If you are especially skilled in forestry, you can work your way up from technician to professional.

____ 3. All foresters prefer to work outdoors and are often frustrated by office work.

____ 4. Forestry is considered a profession and advancement comes through education.

____ 5. People in forestry feel an obligation to society.

____ 6. As you move up the career ladder, you spend more time in the forest.

____ 7. Forestry is not only working with trees, it also involves working with people and teaching them about forests.

____ 8. Because of the rigors of outdoor work, many people leave the forestry profession after the age of 30.

____ 9. The key to a successful forestry career is knowledge about trees.

___ 10. As a profession, forestry pays less than some others.

OBJECTIVE 3

Match areas of study in forestry to their correct definitions.
Write the correct letters in the blanks.

____ 1. The identification and classification of trees

____ 2. Managing tourist or visitor populations and also managing the natural resources involved in leisure-time activities in the forests and watersheds

____ 3. The study of plant populations and their breeding characteristics

____ 4. Methods of fire prevention and suppression; insect and disease control; guarding against animal and wind damage; education and enforcement to control human damage and misuse of forests

____ 5. Carrying out guidelines, policies and procedures to maintain smooth operation

____ 6. Harvesting and marketing the forest crop and other resources of the forest which are made into various forest products; includes valuation and regulations

____ 7. Study of financial analyses related to forestry and how forestry impacts local, state, regional, national and international economies; includes valuation and inventory

____ 8. The practical application of scientific, economic, and social principals to the operation of forest property; includes valuation and inventory

____ 9. The study of watersheds and water movement as they relate to forest management practices

____ 10. A science covering the life history and general characteristics of forest trees and stands, with a focus on ecological factors

a. Business administration
b. Dendrology
c. Drainage management
d. Endocrinology
e. Forest ecology (silvics)
f. Forest economics
g. Forest management
h. Forest protection
i. Forest recreation
j. Forest regulation
k. Forest technology
l. Forest utilization
m. Genetics
n. Hydrology
o. Hydroponics
p. Line forestry
q. Measurements
r. Physiology
s. Plant pathology

___11. Communications; working with the public and with corporations, institutions and legislators to create greater understanding, awareness and recognition of values and issues related to forestry

___12. The application of scientific principles to cultivating forest trees for maximum yields of crops and uses

___13. The study of plant diseases and disorders

___14. Taking care of trees in cities

___15. Managing forested areas surrounding electric or telephone lines

___16. Determining desirable strategies and actions for greatest good and the least harm; uses valuation and regulation studies to make decisions

___17. Determining the volume and growth of logs, single trees, and timbered areas to predict production and yield; includes valuation and regulation

___18. Chemical and physical properties of various types of woods, their behavior in different weather and moisture conditions; and their various uses

___19. The chemical, physical and biological properties of soils that supports trees and other forest vegetation; the protection against its loss and erosion and the conservation and management of forest soils

___20. Maintaining habitats and regulating populations of game and nongame animals and fish

t. Plant oncology

u. Policy making

v. Public relations

w. Silviculture

x. Soil science

y. Surveying

z. Urban forestry

aa. Utilities forestry

bb. Wildlife and fisheries management

cc. Wood product manufacturing

dd. Wood technology

OBJECTIVE 4

State educational requirements for nonprofessional and professional forestry positions.

1. Level 1—Forestry workers or aides and forestry technicians

____

____

2. Level 2—Professional Foresters

____

____

3. Level 3—Specialists

____

____

OBJECTIVE 5

Select from a list personal requirements for a career in forestry. Write an "X" in the blank before each correct answer.

____ 1. Is able to work without direct supervision

____ 2. Can work long hours at a desk reading and writing reports, keeping records, planning, and designing

____ 3. Enjoys measurements and math

____ 4. Enjoys all weather conditions

____ 5. Can walk long distances

____ 6. Enjoys outdoor work

____ 7. Has no family obligations

____ 8. Has another source of income

____ 9. Has computer expertise

___ 10. Is interested in science and enjoys studying science

___ 11. Likes helping others

___ 12. Can use short-term results to establish long-term goals

___ 13. Has a high IQ in math, science, and chemistry

___ 14. Has a desire to contribute to the broad issues of our world ecology

___ 15. Likes to wear a uniform

___ 16. Interested in trees, plants and animals

___ 17. Is physically strong

___ 18. Likes to be alone most of the time

___ 19. Enjoys working with people

___ 20. Has good communication skills

OBJECTIVE 6

List advantages and disadvantages of a forestry career.
Give four advantages and two disadvantages

Advantages

____

____

____

____

____

____

____

____

Disadvantages

____

____

____

____

____

____

____

____

OBJECTIVE 7

Match organizations that employ people trained in forestry to their descriptions. Write the correct letters in the blanks.

____ 1. Private forestry operations that are involved in the production of trees.

____ 2. Manufacture lumber and wood products, furniture and fixtures, paper and pulp products.

____ 3. Manage the resources of Federal lands including water, timber, forage, wildlife and recreational opportunities.

____ 4. Manages privately-owned forest land, may direct or advise on logging operations and timber sales.

____ 5. Involved in a wide variety of forestry activities including teaching, research, extension, administration, design and analysis, public relations and information.

____ 6. Offer technical assistance to timberland owners and forest products manufacturers; involved in production, research, education, fire suppression, and enforcing state laws related to fire and forest protection.

a. Farmers and ranchers

b. Federal agencies

c. Forest products industries

d. Forestry consultant

e. Libraries

f. Newspapers

g. Prison education systems

h. Public relations agencies

i. Public and private institutions and agencies

j. Tree farms and nurseries

k. State agencies

OBJECTIVE 8

Identify the communications skills required in given situations. Select the answer that BEST describes the skills needed and write the correct letter in the blank.

Speech communication

____ 1. Anna Tornelli has the responsibility for designing the communication chain of command for the fire-fighting organization, from Headquarters to air support to the food and water trucks supplying the ground crews. She has training and experience in which skill?

a. Interpersonal communication

b. Public speaking

c. Systems communication

____ 2. An environmental conservation group has organized a nationwide publicity campaign to stop timber harvesting in a section of Arkansas' Ouachita National Forest. Tom O'Carroll is with the Forest Service and Sue Morninghawk is a public relations specialist hired by the National Forest Products Association. They will appear on television and speak before groups across the country to convince Americans that planned timber cutting will not damage the forest or the ecology and will produce valuable goods.

a. Interpersonal communication

b. Public speaking

c. Systems communication

____ 3. Phil and Chen are surveyors. They work together as a team, surveying miles of forested land daily. What type of communication skills do they use on the job?

a. Interpersonal communication

b. Public speaking

c. Systems communication

____ 4. Al Hernandez, like many foresters, is an easy-going man. He manages a logging company with about 300 employees. This morning Hal Robertson from the equipment barn stomped into his office with his jaw set and his face red with anger. Which skill will Al use to handle this situation?

a. Interpersonal communication

b. Public speaking

c. Systems communication

Written communications

____ 5. Troy Jensen has to fire a radio dispatcher for using drugs. The law says the employee must be notified in writing. Which type of writing is called for so that Troy and the employee will have legal proof of notification?

a. Technical writing

b. Business correspondence

c. Report writing

____ 6. Which writing skill would be used to find out about current job openings in the state forests and state parks?

a. Technical writing

b. Business correspondence

c. Report writing

____ 7. A manual for winter survival in open country and a user's guide for a computer program require skills in

a. Technical writing

b. Business correspondence

c. Report writing

NOTICE The following assignment sheets are not part of the written test. If these activities have not been completed, check with your instructor.

OBJECTIVE 9 **Identify state and local employment opportunities.** SCORE ________

OBJECTIVE 10 **Write a thank-you letter.** SCORE ________

OBJECTIVE 11	**Outline a presentation on forestry careers.**	SCORE ______
OBJECTIVE 12	**Give a presentation about a career in forestry.**	SCORE ______

WRITTEN TEST ANSWERS

INVESTIGATE FORESTRY CAREER OPPORTUNITIES

II

OBJECTIVE 1

1. f
2. b
3. d
4. g
5. h
6. a
7. n
8. j
9. m
10. o
11. p
12. r
13. bb
14. t
15. z
16. s
17. aa
18. cc

OBJECTIVE 2

1, 4, 5, 7, 10

OBJECTIVE 3

1. b
2. i
3. m
4. h
5. a
6. l
7. f
8. g
9. n
10. e
11. v
12. w
13. s
14. z
15. aa
16. u
17. q
18. dd
19. x
20. bb

OBJECTIVE 4

1. Level 1 - Requires a high school education or two-year associate degree
2. Level 2 - Four-year college degree
3. Level 3 -Advanced college degrees

OBJECTIVE 5

1, 2, 3, 6, 10, 11, 12, 14, 16, 19, 20

OBJECTIVE 6

Advantages

Answers may include any four of the following:

- Good working conditions
- Reasonable pay
- Longevity
- Service to others
- Job opportunity
- Variety of experience

Disadvantages

Answer must include both:

- Isolation
- Dangerous work

OBJECTIVE 7

1. j
2. c
3. b
4. d
5. i
6. k

OBJECTIVE 8	1. c
	2. b
	3. a
	4. a
	5. b
	6. b
	7. a
OBJECTIVE 9	Refer to answers to Assignment Sheet 1.
OBJECTIVE 10	Refer to answers to Assignment Sheet 2.
OBJECTIVE 11	Refer to answers to Assignment Sheet 3.
OBJECTIVE 12	Refer to answers to Assignment Sheet 4.

OBJECTIVE SHEET

IDENTIFY FORESTS AND FOREST PRODUCTS

III

INTRODUCTION

In this unit you'll learn where wood comes from and what we do with the raw materials. Although we are concerned mainly with U.S. forests and, more specifically, the forests and forest products in our own state, we are influenced by trees, forests, and products from all over the world.

Wood is a good friend, working for us in ways we may not recognize. Learning to know the types of wood and their characteristics helps enrich our awareness and appreciation of the world around us. It also means that when we buy wood products or have a need for wood, we know what kind is best suited to our needs.

PREREQUISITES

None

UNIT OBJECTIVE

After completing this unit, the student should be able to identify major world, U.S., and state forests, name trees found in these forests, and identify forest products. The student will demonstrate these competencies by completing the assignment sheets and written test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with forests and forest products to their correct definitions.
2. Distinguish between softwoods and hardwoods.
3. List characteristics of forest areas of the world.
4. Identify forest regions of the United States on a map.
5. List one evergreen and one broadleaf tree from each region.
6. Name the principal species associated with the forest regions of Oklahoma.
7. Select from a list physical properties of wood important to wood uses.
8. Choose the best word or phrase to complete statements about forest production.
9. Arrange in order Oklahoma wood products according to their importance to the state economy.

10. Make a collection of wood. (Assignment Sheet 1)

11. Identify wood products. (Assignment Sheet 2)

PREPARATION

- Obtain materials to supplement unit.

  NOTE: See Suggested Resources.

- Review instructional outline for this unit. Modify time frames to suit class needs and plan activities for each class period.

- Study the specific objectives to determine those you will cover in your presentation. Decide also which objectives should be taught to which students.

- Determine scope and sequence of objectives that you add. Design and develop support materials, including evaluation techniques, for additional objectives.

- Determine how you will schedule time for students to demonstrate competence in the required procedures.

- Invite a representative from a local merchandising or manufacturing company, or a panel of people involved in several phases of growth, harvesting, merchandising, and manufacturing of wood to speak to the class. Have them discuss and provide an overview of the wood products industry.

  NOTE: Supply guest speakers with specific objectives and other appropriate sections of the unit.

- Arrange a field trip to a mill or manufacturing plant.

- Arrange a field trip to a lumberyard to identify different types of lumber and different wood products.

- Obtain pictures of Sequoia and California redwoods.

DELIVERY

Objective 1

- Show or ask students to name locally-made wood products.

- Have students look around the room and identify wood products.

- Ask them to name wood products that don't look like wood before reading the unit.

- Review terms with students.

Objective 2

- Demonstrate and discuss the differences between softwoods and hardwoods.
- Have students look at the cell structure and porosity in Supplement 2.
- Discuss and compare the uses of hardwoods and softwoods.
- Time students driving nails into hardwoods and into softwoods.

Objective 3

- Discuss forest regions of the world.
- Refer students to Supplement 3.
- Have students locate forest areas on a map of the world or on a globe.
- Ask students to bring objects made of mahogany, teak, or other non-American wood, or wood objects that were manufactured elsewhere in the world.
- Ask students to tell where their families originally came from before immigrating to America, and to identify the type of wood grown in that area.
- Have students give individual reports on other countries and the wood and wood products from those countries.

Objectives 4 and 5

- Discuss forest regions of the United States.
- Locate regions closest to you.
- Discuss the environmental conditions that determine the regional differences.
- Draw from students' knowledge of different kinds of trees to discuss those not familiar to your region.
- Show students slides or pictures of species not available in your region, especially the giant sequoias and redwoods on the Pacific coast.

Objective 6

- Discuss forest regions of Oklahoma or your state.
- Locate your area and the areas closest to you.
- Discuss the environmental conditions that determine the regional differences.
- Have students complete Assignment Sheet 1.

Objective 7

- Discuss the physical properties of wood that are important to wood uses.
- Refer students to Supplements 2 and 4.
- Have students complete the experiments and record their observations in Activity Sheet 2.
- Discuss personal experiences with various wood conditions, such as splitting, rotting, coloring with age, etc.
- Invite a forester to discuss the various properties of woods and their relationship to wood products.

Objective 8

- Discuss the whole process of forest production, from management and planning through wood product manufacture.
- Show the video *Total Wood Use: A Quality Commitment.*
- Stress the importance of reforestation for supplying the need for wood in our society.
- Discuss the need for wood products today and the consequences if there were not enough wood.

Objective 9

- Discuss wood products from Oklahoma or your local area. This information can be obtained from your state forestry extension specialist, district office, or the Forest Service.
- Refer students to Supplement 5 and have them locate the mills nearest your area.
- Make a copy of *Oklahoma Forest Industries Buyer's Guide* available to students.
- Encourage students to complete the bulletin board activities in Activity Sheet 3.
- Use Supplements 6 and 7 to impress upon students the variety and range of products made from wood.
- Have students make a collection of wood using Assignment Sheet 2 and make paper using Activity Sheet 4.
- Invite a wood technologist to discuss the various properties of woods and their relationship to wood products.

APPLICATION

Objective 10

- Use Assignment Sheet 1 to help students learn to recognize different types of wood and to familiarize them with characteristics of different woods.

Objective 11

- Use Assignment Sheet 2 to help students recognize wood products around them, especially products that don't look like wood.

EVALUATION

Written test

- Explain to students that they will be asked to demonstrate on the written test actions listed in the specific objectives.
- Give written test.

  NOTE: The written test may be given in sections if desired.
- Evaluate students on assignment sheet activities if not previously done.
- Reteach and retest if necessary.

- Complete appropriate section of competency profiles.

- Review individual and group performance in order to evaluate teaching methods. Adjust scope, sequence, or instructional approaches for additional lessons as required.

SUGGESTED RESOURCES

Audiovisual Materials

- *Hardwood - the Natural Choice*, 1/2" VHS, 19:49, color, $25. Comparison of the types of hardwoods used in different styles of furniture. Discusses veneers and hardwoods and the advantages of veneer. Fine Hardwood Association, 5603 W. Raymond Street, Suite 0, Indianapolis, IN 46241.

- *Total Wood Use: A Quality Commitment*, 1/2" VHS, 15 minute, color. Shows harvesting and production processes at the Weyerhaeuser processing plant, Wright City, Oklahoma.

  NOTE: The above videos are available to Oklahoma teachers on a free loan basis from the Oklahoma Department of Vocational and Technical Education, Resource Center, ATTN: Instructional Media Specialist, 1500 West Seventh Avenue, Stillwater, OK 74074. Out-of-state teachers must order from the address listed with the video.

- *Sawmill Tour*, 15 minute slide-cassette presentation of the manufacturing process. Shows the total operation for Southern Pine from harvesting through lumber shipment. Available for loan or purchase from Southern Forest Products Association, P.O. Box 52468, New Orleans, LA 70152. Order No. AV10.

The programs listed below are available on a free-loan basis from the Forestry Extension Program at Oklahoma State University, 242 Agricultural Hall, Stillwater, OK 74078, (405) 744-5444.

- *The Many Advantages of Pressure Treated Southern Yellow Pine*, 46 slides with cassette. Promotes CCA treated southern yellow pine.

- *The Un-Pine Forest*, 102 Slides with cassette. USDA Forest Service and the Southern Hardwood Lumber Manufacturers Association. Describes the Southern Hardwood Resource from a utilization perspective.

- *Understanding Hardwood Lumber*, 80 slides with cassette, Department of Forestry and Natural Resources, Purdue University. Describes the structure and uses of hardwood lumber.

- *Wood Drying*, 50 slides, Virginia Polytechnic Institute and State University. Self-explanatory slide set dealing with all phases of wood drying.

Publications

- *Catalog, Southern Forest Products Association*, P.O. Box 52468, New Orleans, LA 70152. Offers literature, audiovisual programs and other materials. Includes:
    - *Our Forests*, 28-page teaching aid for a unit on trees and forests. Order No. 204.
    - *Forestry in the South*, Southern Forest Products Association. Order No. 200.
    - *Questions & Answers About Forests*, Reveals some surprising facts about forest ownership, products, cultivation and economics. Order No. 202.

- *Green America, From Forest to Market*, 1982. Large color poster about forest products, includes "A Tale of 3 Trees" describing the major trees and their products from three forest regions: douglas fir, aspen, and slash pine. Pictures of a variety of forest products, modern and historic forestry. *Green America* Book also available. New *Green America* posters are produced periodically. Available at low cost from American Forest Council, 1619 Massachusetts Avenue, N.W., Washington, D.C. 20036, (202) 463-2455. Order No. 28.

- *Oklahoma Forest Industries Buyer's Guide*, 1987-88, State Department of Agriculture, 2800 N. Lincoln, Oklahoma City, OK (405) 521-3864, ext. 315 or 318.

- Publications Index, American Plywood Association, P.O. Box 11700, Tacoma, WA, 98411-0700, (206) 565-6600. Most items are free to educators in quantities of 25 or less.

- Catalog. American Paper Institute, 260 Madison Avenue, New York, NY 10016, (212) 340-0600

- "Our Vanishing Forests," E. Annie Proulx, *Organic Gardening*, March, 1989.

- "The Politics of Tropical Deforestation," T.M. Pascal, *American Forests*, Nov.-Dec., 1988, p. 21.

- "World Forests," Barry Walden, *American Forests*, Nov.-Dec., 1989, p. 28.

Speakers

Oklahoma Natural Resources Speakers Bureau sponsored through Oklahoma State University, Division of Agriculture, Oklahoma Cooperative Extension Service - Forestry, Oklahoma Conservation Commission and the Oklahoma Forestry Association. Lists speakers on a variety of forestry-related topics. Speakers operate on a time-available basis. Request a listing of speakers, programs, slide presentations and videotapes from your local extension office or from:

Dr. Steve Anderson
Forestry Dept.
Oklahoma State University
239 Agricultural Hall
Stillwater, OK 74078
(405) 744-9431

Dave Marcouiller
Forestry Dept.
Oklahoma State University
242 Agricultural Hall
Stillwater, OK 74078
(405) 744-5444

Teachers from outside of Oklahoma should contact the Forestry Extension Office in their state.

Other Media

- Paper-making kits are available without charge from:

  Oklahoma Forestry Association
  P.O. Box 517
  Broken Bow, OK 74728
  (405) 584-6911

  NOTE: One kit provides enough materials to make 50 sheets of paper, 3" in diameter. Limited to two kits per school.

- Wood samples can be obtained from:

  W.P. Stark Lumber Co.
  Fairfax Industrial District
  Kansas City, KS 66115
  (913) 281-1612

  Constantines
  2065 Eastchester Rd.
  Bronx, NY 10461
  1 (800) 223-8087

- Obtain materials available locally:
  - Hardwood and softwood samples, including at least one eight foot piece of 2" x 4" or 1" x 4" board of each type.
  - Beakers, glass bowls or large jars to observe the specific gravity of hardwoods and softwoods.
  - Concrete blocks for Activity Sheet 2.
  - A variety of hardwood and softwood samples from lumber yards and sawmills for students to complete Assignment Sheet 1.
  - Samples of locally-made wood products.
  - A large map of your county and surrounding counties. Contact County Extension Agents, soil survey offices, or election offices.
  - Household items: iron, glass beakers, jars or bowls, and shallow baking pan for making paper.

UNIT REFERENCES

- Anderson, David A. and I. I. Holland, *Forests and Forestry*, The Interstate Printers & Publishers, Inc., Danville, Illinois, 1982.
- Collins, B. McManus, and Fred M. White, *Elementary Forestry*, Reston Publishing Company, Reston, Virginia, 1981.
- Daniel, Theodore W., *Principles of Silviculture*, McGraw-Hill, New York, 1979.
- *Harvesting Forestry Products*, Texas A & M University, College Station, Texas, 1976.
- Stoddard, Charles H. and Glenn M. Stoddard, *Essentials of Forestry Practice*, 4th ed. John Wiley & Sons, New York, 1987.
- *The Encyclopedia of Wood: Wood as an Engineering Material*, Sterling Publishing Co., Inc. New York, 1980.
- Zook, Wayne H., *Constructing and Manufacturing Wood Products*, McKnight Publishing Company, Bloomington, Illinois, 1973.

INFORMATION SHEET

IDENTIFY FORESTS AND FOREST PRODUCTS

III

OBJECTIVE 1

Match terms associated with forests and forest products to their correct definitions.

- **By-product**—Anything produced in the course of making something else

  EXAMPLES: Charcoal, pulp fiber used for animal bedding, resins for glues and cosmetics

- **Conifer**—Cone bearing, needle-leaved tree

- **Deciduous**—Losing leaves in the winter

- **Grain**—The direction of alignment and arrangement of wood structures

- **Natural regeneration**—Renewal of the forest by self-sown seeds, sprouts, roots, etc.

- **Plywood**—Sheets of construction wood made of three or more sheets of veneer glued together, with the grain of successive sheets laid crosswise

  NOTE: The crosswise grain makes plywood strong, resistant to shearing, splitting, puncture and hardware tearing out of the edge. Because it can be made much larger than boards, construction with plywood is fast and efficient.

- **Pores**—Tiny openings in the surface through which air or fluids can be absorbed or discharged

  NOTE: "Pore" originally meant a "passage or channel."

- **Pulpwood**—Wood cut or prepared primarily for processing into wood pulp for later manufacture into paper, fiberboard or other products

- **Sawlogs**—Trees that yield logs suitable in size and quality for the production of lumber

- **Silviculture**—The art of producing and tending a forest; controlling the forest establishment, composition and growth

- **Specific gravity**—The weight of a substance compared with the density of distilled water

  NOTE: Weight in wood is determined by the amount of gum, resins and other substances; the size of the cell cavities; and the thickness of cell walls.

- **Texture**—Size and amount of woody elements

- **Veneer**—A thin sheet of wood used for plywood and decorative furniture surfaces

OBJECTIVE 2

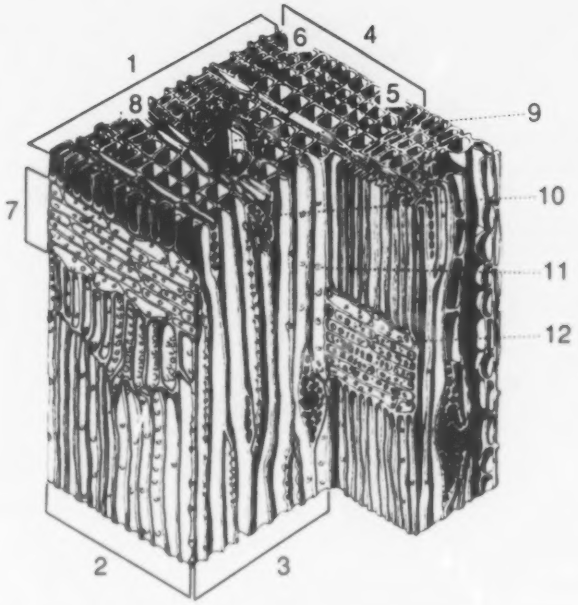
Distinguish between softwoods and hardwoods.
(Supplement 2)

Commercial woods are divided into softwoods and hardwoods. This classification refers to their cell properties and not to the hardness or softness of wood. In fact, some hardwoods, such as cottonwood are actually softer than the wood from some pines and firs classified as softwoods.

Softwoods

- Evergreens
- Conifers
- Close-grained, having close-knit and nonporous cell structure
- Includes pines, spruces, and firs

  NOTE: An exception is bald cypress, a deciduous softwood.



1. Cross-section face
2. Radial face
3. Tangential face
4. Annual ring
5. Earlywood
6. Latewood
7. Wood ray
8. Fusiform ray
9. Vertical resin duct
10. Horizontal resin duct
11. Bordered pit
12. Simple pit

Wood Structure Of A Softwood

Courtesy of Instructional Materials Service, Texas A & M University, College Station, Texas.

Hardwoods

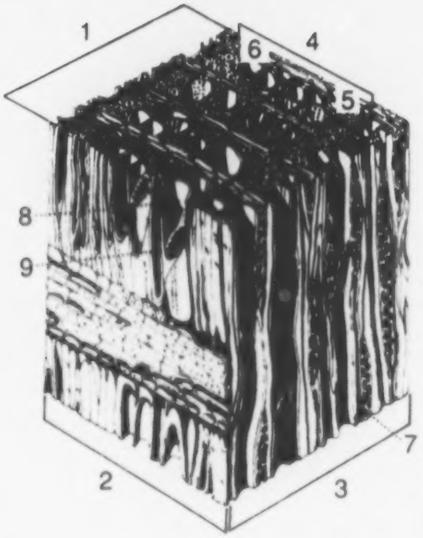
- Broadleaved trees
- Usually deciduous (lose their leaves in winter)

  NOTE: Exceptions are evergreen broadleaves such as holly, magnolia and cherry laurel.

- Open-grained, having a porous cell structure

  NOTE: Cherry and maple have such small cell structures that they are considered close-grained even though they are from the hardwood family.

- Includes oaks, ashes, birches, maples, and others



1. Cross-Sectional Face
2. Radial Face
3. Tangential Face
4. Annual Ring
5. Earlywood
6. Latewood
7. Wood Ray
8. Vessel
9. Perforation Plate

Wood Structure Of A Hardwood

Courtesy of Instructional Materials Service, Texas A & M University, College Station, Texas.

OBJECTIVE 3

List characteristics of forest areas of the world.
(Supplement 3)

About 22%, or almost a quarter, of the earth's land area (except the polar regions) is forested. These areas can be divided into three broad types of forests, depending on temperature.

- **Tropical rain forest**
  - Makes up about 50% of the entire forest area of the world
  - It is the most highly complex of all the forests
  - Ranges from dense jungle to small groups of trees on the grasslands
  - Trees have large, evergreen leaves and varied heights from 15-150 feet high
  - May have as many as 80 species growing on a single acre
  - Grows in high humidity

- Is the source of valuable tropical hardwoods such as mahogany, eucalyptus, and teak
- Grows in areas where the average temperature is about 80° F (27° C) and temperatures never fall below 40° F (5° C)
- Trees grow, die, and decompose quickly

NOTE: The destruction of tropical rain forests is a current issue in world affairs. Much of the rain forest is being cut for industry and for agricultural purposes as economic hardship forces small farmers to clear and plant more land for basic survival needs. The loss of the forest is causing concern because the rain forest supplies a significant amount of the world's oxygen and is important in wildlife ecology and in the manufacture of medicines. See Supplement 3.

Tropical Rain Forest

Courtesy of USDA, Forest Service.

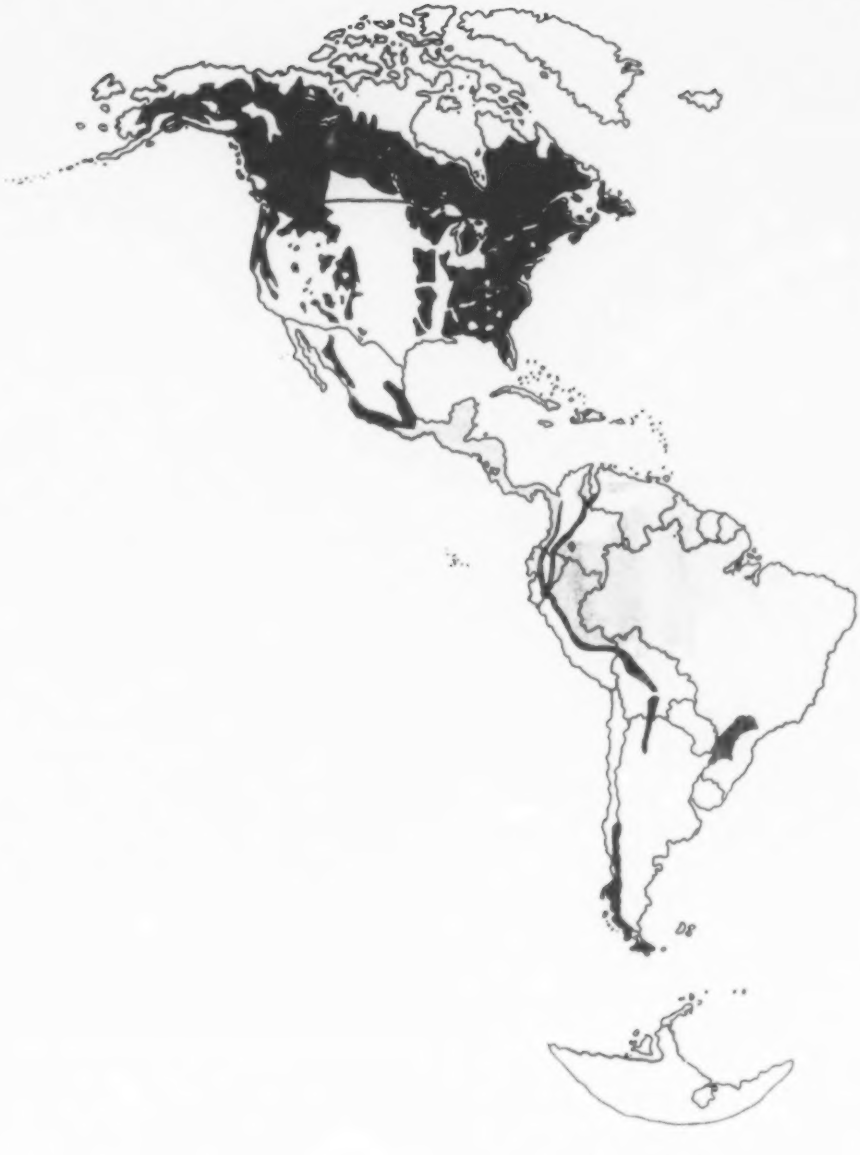
- **Temperate hardwood forest**

  NOTE: Worldwide, many areas once covered with the best type of hardwood forest have been cleared for agriculture.

  - Makes up about 15% of the entire forest area of the world
  - Has a well-defined tree-top level (canopy)

- Leaves are generally simple, bright green, and fall off in winter
- Forests grow in the warmer portions of the temperate zone with about 23 inches (600mm) of rainfall per year
- A large number of species grow in the hardwood forests, including oaks, beeches and other trees reaching a height of 75-100 feet (22.8-30 meters)
- Conifers are often found mixed in hardwood stands.

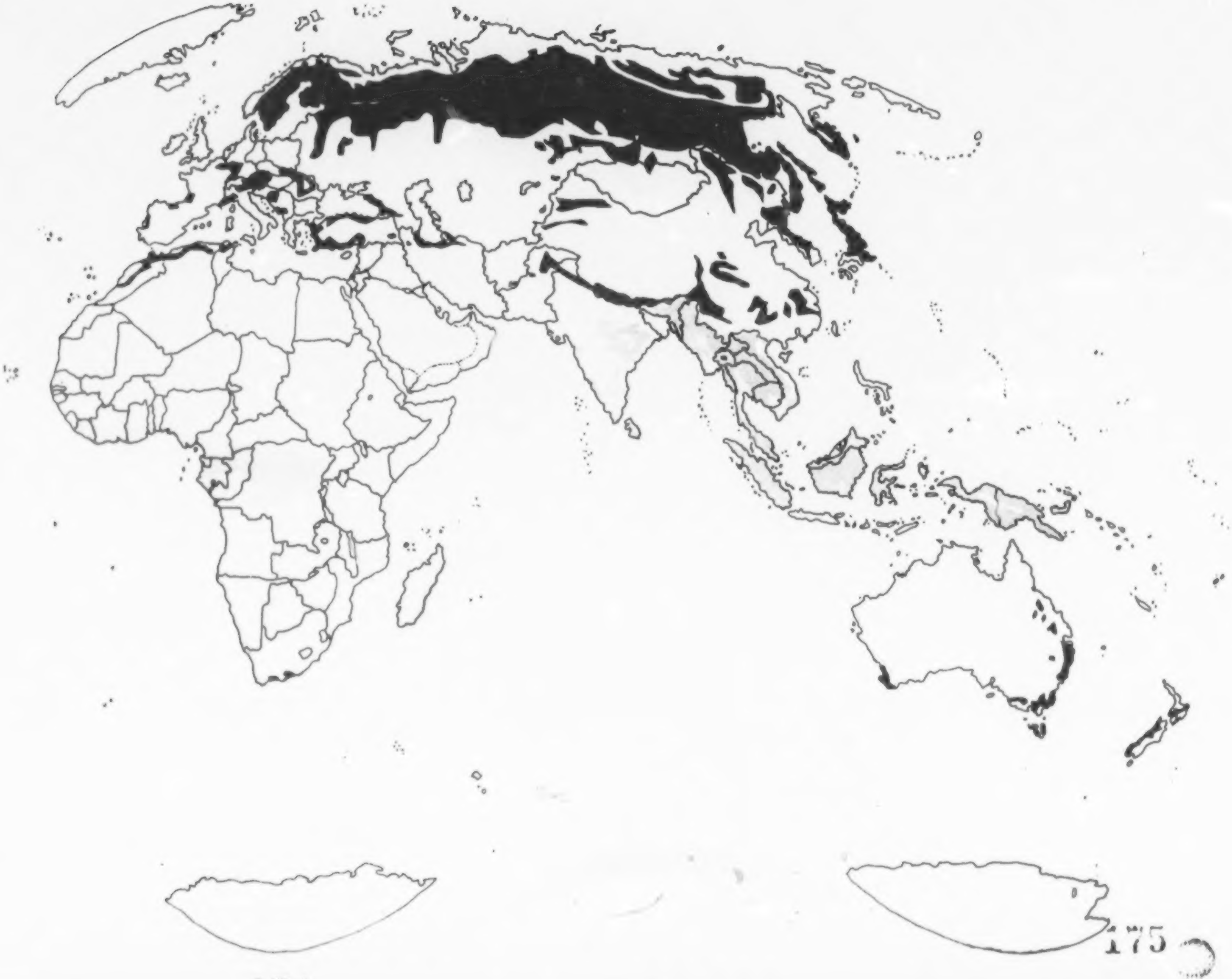
- **Coniferous forest**
  - Makes up about 35% of the entire forest area of the world
  - Is the most important in terms of usefulness and forest management
  - Consists of a stand of tall, straight trunks with relatively small tops (crowns) reaching about 100 (30 m) feet high
  - Trees have thick, dark evergreen needles that let very little light pass to the forest floor so the floor is a carpet of needles
  - Consists of only a few species and produces the most sawlogs of all the forests
  - Grows in the colder parts of the north temperate zone where average summer low temperature is about 50° F (10° C) and winters are cold
  - Management is most highly developed for these forests because of the heavy use of softwood timber and the rapid growth of high quality trees



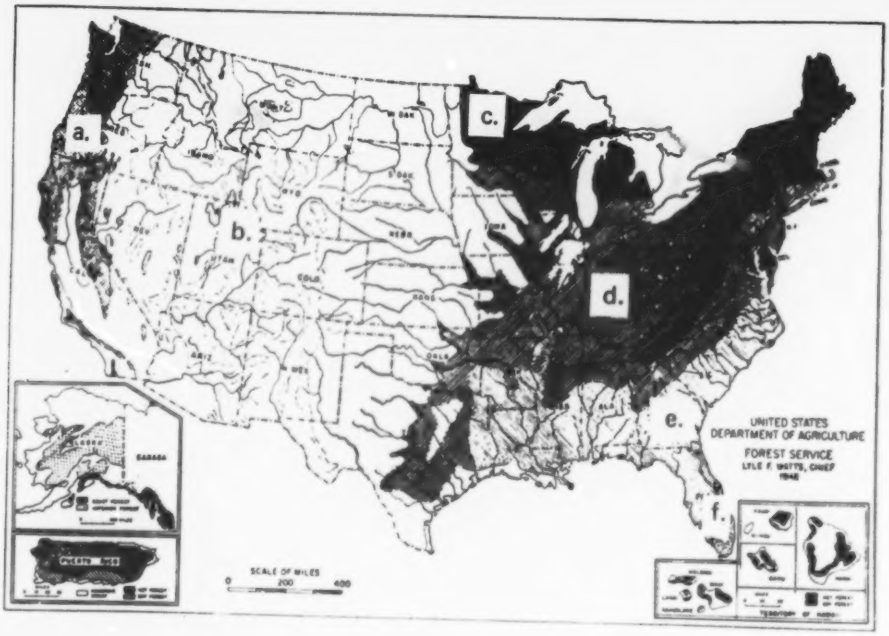
General Distribution Of Forests In The Western Continents

INFORMATION SHEET - Forestry
III - 18

Forests Of The Eastern Continents



OBJECTIVE 4 | **Identify forest regions of the United States on a map.**



a. Pacific coast
b. Rocky Mountain
c. Northern
d. Central hardwood
e. Southern
f. Tropical

OBJECTIVE 5 | **List one evergreen and one broadleaf tree from each region.**

There are over 860 species (kinds) of trees in United States forests, growing on about 737 million acres. About 2/3 of these forests are used as commercial forests. The other third are non-commercial wooded areas (1) that are hard to reach and impractical to harvest, (2) that grow unusable timber, and (3) that are reserved for parks, wilderness lands, or game refuges.

The United States is divided into six forest regions, each with different climate and soil conditions and growing different types of trees.

Pacific coast

NOTE: The largest trees in the world grow in the forests of the Pacific coast—the redwoods, growing to over 300 feet high, and the giant sequoias with trunks measuring 30 feet in diameter. See Activity Sheet 1.

West Coast Forest

Courtesy of USDA, Forest Service

Evergreens

- Douglas fir
- Ponderosa pine
- Western hemlock
- Sitka spruce
- Sugar pine
- Lodgepole pine
- Noble fir
- Sequoia
- Redwood
- Incense cedar
- White fir

Broadleaf trees

- Red alder
- Big-leaf maple
- Oaks
- Black cottonwood

- **Rocky Mountain**

  NOTE: Also called the western region

Evergreens	Broadleaf trees
Ponderosa pine	Aspen
Lodgepole pine	
Douglas fir	
Western red cedar	
Western hemlock	
Western white pine	
Engleman spruce	
White fir	
Western larch	

- **Tropical**

  NOTE: The forests found in the Florida everglades are a good example of tropical forests. They make up the smallest forest region in America. None of the trees are important as commercial timber, but the mangroves serve an important ecological role. Their long stilt-like roots grow in the mud, trapping debris and soil particles washed in by the tides. Over the years this material builds up and extends the shoreline.

Broadleaf trees
Mahogany
Bay
Mangrove
Palm

- **Southern**

  Evergreens

  Yellow pines:
    - Loblolly pine
    - Shortleaf pine
    - Slash pine
    - Longleaf pine

  Virginia pine
  Bald cypress

  Broadleaf trees

  Sweetgum
  Blackgum (tupelo)
  Oaks
  Maples
  White ash
  Hickory
  Yellow poplar
  Walnut
  Cottonwood
  Pecan

- **Central hardwood**

  Evergreens

  Virginia pine
  Shortleaf
  Pitch Pine
  Eastern red cedar
  Eastern hemlocks

  Broadleaf trees

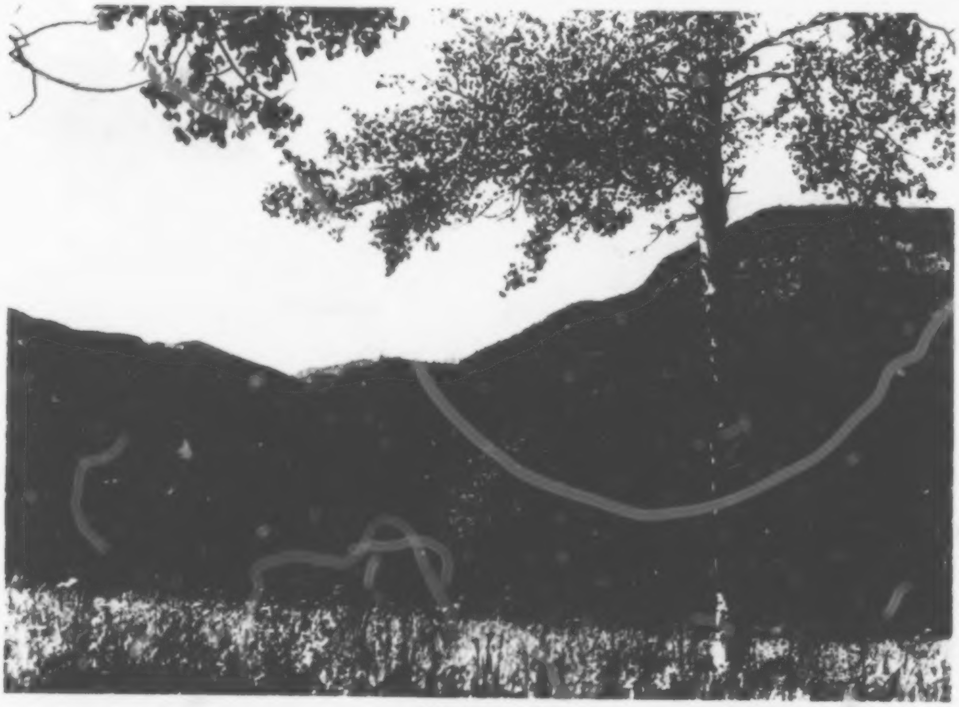
  Northern red oak
  Hickory
  Elm
  Red maple
  White ash
  Sycamore
  Cottonwood
  Black walnut
  Blackgum (tupelo)
  Yellow poplar
  Sweet or red gum

- **Northern**

  NOTE: Also called the eastern forest.

  Evergreens
  - Eastern white pine
  - Red spruce
  - White spruce
  - Black spruce
  - Norway or red pine
  - Jack pine
  - Balsam fir
  - White cedar
  - Eastern hemlock

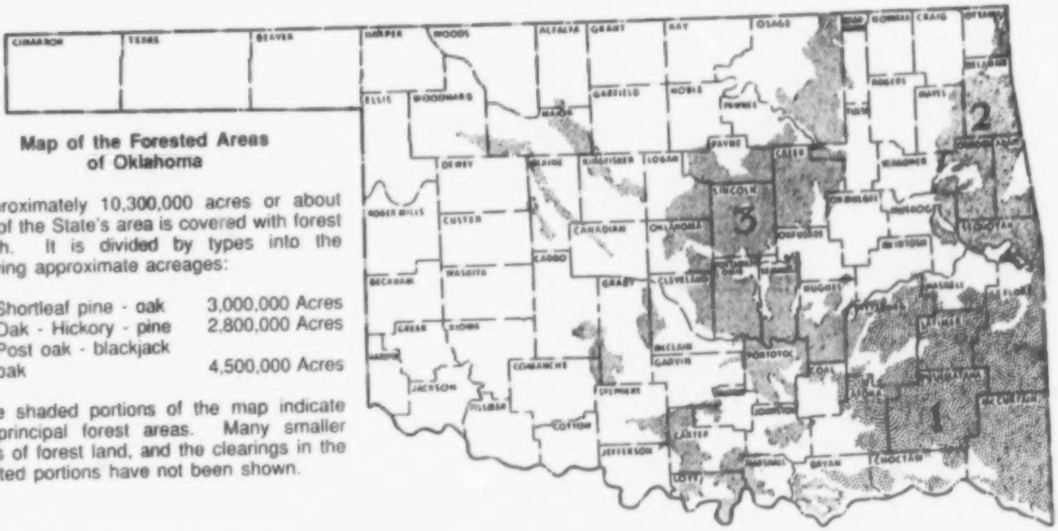
  Broadleaf trees
  - Beech
  - Northern red oak
  - White oak
  - Aspen
  - Yellow birch
  - Paper birch
  - Black birch
  - Black walnut
  - Sugar maple
  - Blackgum (tupelo)
  - White ash
  - Black cherry
  - Basswood



Northern Forest

Courtesy of Forestry Service Collection, National Agricultural Library

OBJECTIVE 6 | **Name the principal species associated with forest regions of Oklahoma.** (Assignment Sheet 1)


CIMARRON
TEXAS
BEAVER
HARPER
WOODS
ALFALFA
GRANT
KAY
OSAGE
NOWATA
CRAIG
OTTAWA
ELLIS
WOODWARD
GARFIELD
NOBLE
PAWNEE
ROGERS
MAYES
DELAWARE
DEWEY
BLAINE
KINGFISHER
LOGAN
PAYNE
CREEK
WAGONER
ROGER MILLS
CUSTER
CANADIAN
OKLAHOMA
LINCOLN
OKMULGEE
MUSKOGEE
SEQUOYAH
BECKHAM
WASHITA
CADDO
GRADY
CLEVELAND
POTTAWATOMIE
OKFUSKEE
MCINTOSH
HUGHES
HASKELL
LE FLORE
LATIMER
GREER
KIOWA
HARMON
JACKSON
TILLMAN
COMANCHE
COTTON
STEPHENS
MCCLAIN
GARVIN
PONTOTOC
COAL
PITTSBURG
PUSHMATAHA
MCCURTAIN
JEFFERSON
CARTER
JOHNSTON
ATOKA
LOVE
MARSHALL
BRYAN
CHOCTAW
1
2
3

Map of the Forested Areas of Oklahoma

Approximately 10,300,000 acres or about 24% of the State's area is covered with forest growth. It is divided by types into the following approximate acreages:

1. Shortleaf pine - oak	3,000,000 Acres
2. Oak - Hickory - pine	2,800,000 Acres
3. Post oak - blackjack oak	4,500,000 Acres

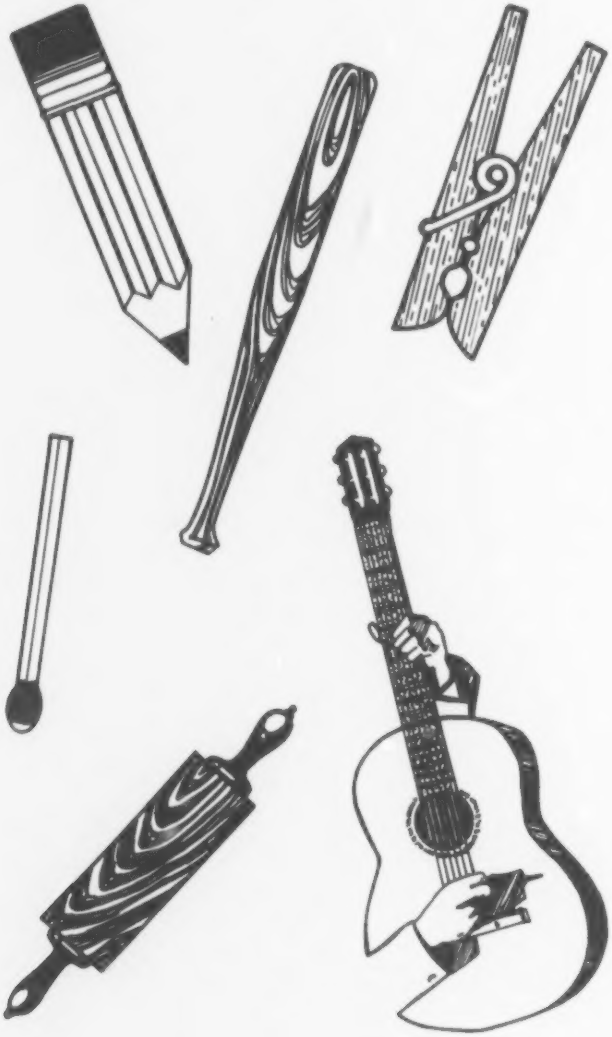
The shaded portions of the map indicate the principal forest areas. Many smaller areas of forest land, and the clearings in the forested portions have not been shown.

Courtesy of Oklahoma Forestry Division, State Department of Agriculture.

OBJECTIVE 7

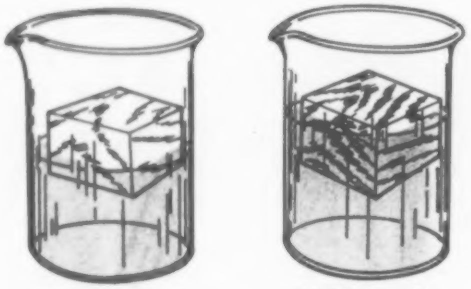
Select from a list physical properties of wood important to wood uses. (Supplement 4, Activity Sheet 3)

The properties of wood determine how it will be used. Wood is also graded according to its ability to be compressed, nailed, glued, and painted; and its insulation and fire-resistant properties.



- **Specific gravity or weight**

  NOTE: There is a strong relationship between the weight of a wood and its strength. Very dense wood has more woody material, so the cell walls are thicker, stronger, and harder.



Specific Gravity Of Wood

From *Constructing and Manufacturing Wood Products* by Zook. Used with permission of the publisher, Glencoe Publishing Company, a Division of Macmillan/McGraw-Hill School Publishing Company.

- **Grain**

  NOTE: All woods have a grain pattern according to their porosity. Very porous woods have large cells. The cell pattern shows when the wood is cut. Woods with large cells are **open grained**, and woods with less distinct patterns are **close grained**. Oak, mahogany and ash are open grained woods (porous) and pine, cherry, and maples are close grained woods.

- **Strength**

  NOTE: Strength includes **tensile strength,** the resistance of wood to forces that would pull it apart parallel to the grain; **compressive strength,** the ability of wood to resist crushing when forces are applied from opposite ends toward the center, as in posts or boards that hold up weight between the ceiling and floor; **cleavage resistance,** the resistance of wood to split along the grain; and **shock resistance**, the ability to remain stable when a sudden load is applied, as when a baseball hits a bat.

- **Stiffness**

  NOTE: Stiffness is the resistance of a piece of wood to bending. Depending on the use of the wood, a high stiffness rating may be preferred, such as for a ceiling beam; while a more bendable wood is preferred for products that must absorb shock, such as flooring and sports equipment.

- **Bending**

  NOTE: Bending is the ability of a wood to absorb energy as it is slowly loaded. **Impact bending** is related to the energy absorption due to a rapid or falling load—how far it will bend before it breaks.

- **Hardness**

  NOTE: Hardness is measured by the ability of a wood to resist indentation, as from a hammer hit. It's measured by the load required to embed a 0.444-inch ball to one-half its diameter in a direction perpendicular to the grain.

- **Toughness**

  NOTE: Toughness is the ability to absorb a relatively large amount of energy, to withstand repeated shocks and to undergo considerable deformation before breaking.

- **Ability to be stained**

  NOTE: Stain accentuates the natural variations in the wood, giving it a richer, deeper texture than unstained wood. Woods in which the grain can be emphasized with stain are preferred for furniture and decorative uses.

- **Chemical properties**

  NOTE: Chemical properties are important in the ability of wood to absorb moisture, resist corrosion by salt water, and resist decay. Chemical properties also affect the color, smell, and burning quality of woods.

OBJECTIVE 8

Choose the best word or phrase to complete statements about forest production.

Trees are a crop, just as wheat and corn are crops, except that their growing period is 15-50 years instead of a single season. If you trace or describe the production of an agricultural product such as wheat in your area, you'll find the processes for forest production are very similar.

- **Planning and management** are on-going activities. Foresters and land owners work together to identify areas for harvesting. They determine the schedule for intermediate harvesting, called thinning, for all stages of caring for and harvesting the timber, and for the final step in the forestry operation, reforestation.

  Planning and management also means considering when and how to cull diseased or unwanted trees (similar to removing weeds in a farm crop), protect trees from fire, insect, and disease damage, fertilize and improve soil conditions, and all other phases of silviculture and harvesting, including selling the harvested timber.

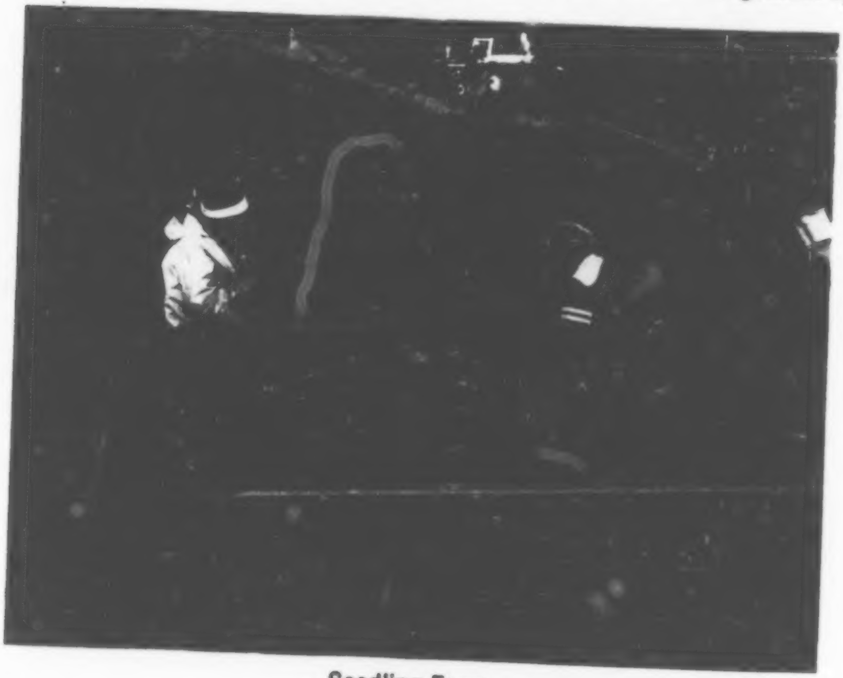
- **Thinning** is the practice of cutting certain trees in an immature stand to increase the rate of growth in the stand. Less desirable trees that compete for light, air, and moisture are removed so that the more valuable trees can thrive. The cut hardwoods usually too small for lumber, are sold for firewood and softwoods are chipped and used as pulpwood or as posts and poles.

- **Harvesting** is the cutting and hauling of timber to a yard, or storage area, or to a processing plant such as a mill. Harvest operations are performed by small, independent logging companies, as well as by large companies.

  NOTE: Large companies harvest trees using heavy equipment and large trucks, while small companies frequently use chainsaws and modified pickup trucks. Larger companies can process branches and small trees, cutting them into chips that are automatically loaded into trucks and then shipped to processing plants. Logging companies frequently leave branches and cuttings on the ground to prevent erosion, provide wildlife habitat, and to decompose, adding organic matter to the soil.

Logging Truck

- **Reforestation** is a critical part of the forest industry. Seedlings can be planted in a harvested area to create a new crop of trees, or natural regeneration can provide for future crops. People often think of harvesting or selling wood as the final step in the forest management program. But reforestation, preparing for the future, is actually the end-point—and the beginning of a new management cycle.



Seedling Farm

Courtesy of USDA, Forest Serivce.

Reforestation insures that forests continue to fulfill their ecological roles and provide recreational areas, and that commercial lumber operations will continue to profit from harvesting timber crops. Most important, reforestation insures that we will have plenty of wood to meet present and future needs, like all crops, driven by consumer demand.

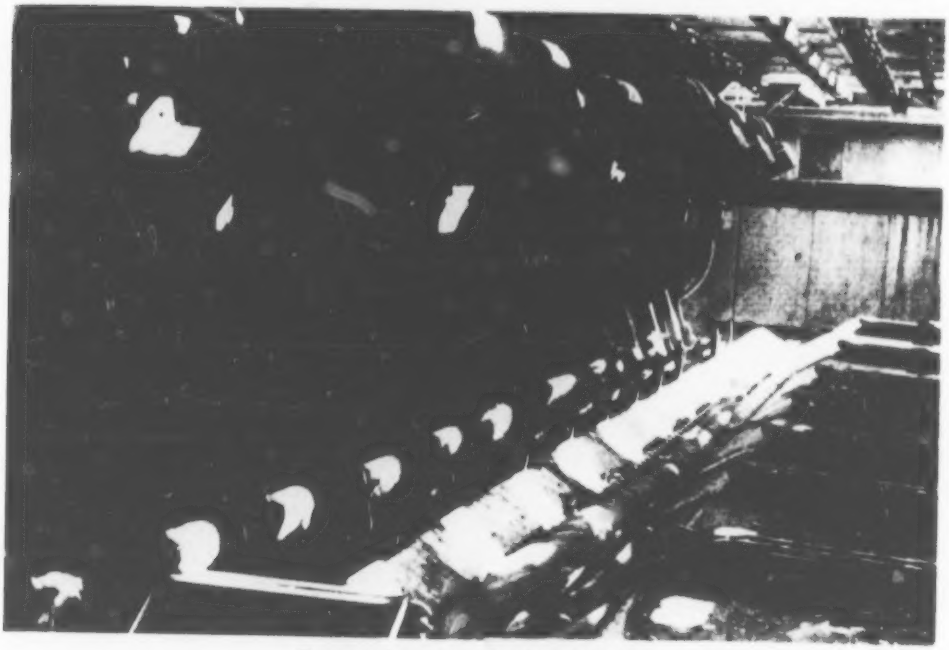
- **Milling** is the first step in wood processing. Logs are sorted for size and type, then cut and treated according to use. In large operations, all parts of the logs are used. A small sawmill or processing plant can specialize in a single product, such as poles or posts, and sell the by-products to other companies. (See Supplement 5)

A large company can produce a wide range of products in various plants, including lumber, plywood, veneer, paper and particle board. Mill products go either directly to distributors such as lumber companies and major building contractors, or to manufacturers who use wood products and by-products.

Milling Process

- **Product manufacturing** uses the processed wood to prepare specific consumer goods such as building materials, writing paper, wrapping paper, matchbook covers, oils, perfumes, camera film, and about 5,000 other products used in homes, schools, business, industry, and agriculture.

  NOTE: According to the Oklahoma Forestry Association, if wood-based packaging and volume handling materials were immediately withdrawn from use, national and international commerce would be paralyzed. Except for glass, metal, and plastic containers, nearly all packagings are wood-based. (See Supplements 6 and 7)



Processing Logs for Lumber

OBJECTIVE 9

Arrange in order Oklahoma wood products according to their importance to the state economy.
(Supplements 5, 6, and 7, Activity Sheet 3)

NOTE: Important Oklahoma industries related to trees, but not in this list, include pecan production, nursery and greenhouse production, and Christmas tree production.

1. Sawlogs

   NOTE: Sawlogs are sections of trees 8 feet and longer, used to make lumber of various dimensions.

2. Pulpwood products

   NOTE: Paper and related products enjoy by far the highest productivity, accounting for almost half the state's forest products industry. Other pulpwood products include particle board, fiberboard, and composition board.

3. Poles and posts

   EXAMPLES: Fenceposts, barn poles, railroad ties, landscape timbers, utility poles

4. Veneer

   NOTE: About 98% of the veneer is made of softwoods and most of that is produced from Southern pine. Walnut and pecan make up 98% of the hardwood veneers.

5. Miscellaneous

   EXAMPLES: Hardwoods such as ash and oak and softwoods such as Southern pine and red cedar are used for furniture, wood handles, charcoal, firewood, and excelsior (wood shavings used for packing and shipping goods)

6. By-products

   EXAMPLES: Bark, shavings, sawdust and chips used as a source of fiber by pulp and paper companies, for heating fuel to power steam and electrical systems, and for animal bedding

THE LONG & THE SHORT OF IT

Forest Resource Facts

- One third of the land in the United States is covered by wooded areas—737 million acres.
- Of all the country's forest land, one-third (255 million acres) cannot be used for crops of trees, for one reason or another.
- The other two-thirds of forest land (482 million acres) is considered "commercial"—capable of growing more than 20 cubic feet of wood per acre per year and not withdrawn legally from timber production and harvesting. Much of this "commercial" forest is not really productive because its low growth doesn't provide sufficient economic return.
- The "productive forest base," on which repeated crops of trees can be grown economically, totals only about 260 million acres—a little more than one acre per person in the United States.

Facts About A Cord of Wood

Measures 4 ft x 4 ft x 8 ft, or 128 cu ft of space, or 80 cu ft of solid wood (subtracting the air space).

A cord of air-dried, dense hardwood (oak, hickory, etc.) weighs about 2 tons (4,000 pounds, of which 15 to 20 percent is water) and has the heating value of a ton of coal or 200 gallons of fuel oil.

Before 1900, when firewood was the primary household heating fuel and houses weren't insulated, it took 20 cords per year to heat the average house.

If we were to go back to this way of life Americans would use **1 billion 600 million** (1,600,000,000) cords of wood each year to heat their homes. It would take **2 billion acres** of productive forest, 50 times the land area of Oklahoma, devoted solely to firewood production to meet this need.

1 Cord of Wood Yields

- 7,500,000 toothpicks; or,
- 1,000 to 2,000 pounds of paper (depending on the process); or,
- 61,370 No. 10 envelopes (standard); or,
- 4,384,000 commemorative-size postage stamps; or,
- 89,870 sheets of bond paper (8 1/2 x 11 inches); or,
- 1,200 copies of the *National Geographic*; or,
- 30 Boston rockers; or,
- 12 dining room tables (each table seats eight).

How Many Trees To Make a Cord?

The number of trees needed to make a cord of wood depends on the size of the trees. Here are approximate guidelines for trees of different D.B.H. measurements. (D.B.H. is Diameter, Breast-High, or 4.5 feet from the ground).

D.B.H. (inches)	Number of Trees to make a cord
2	170.0
4	50.0
6	38.0
8	27.0
10	15.0
12	3.3
14	3.0
16	2.2
18	1.9
20	1.6
22	1.3
24	1.0

- Building an average 1,800 square foot home uses 10,000 board feet of lumber, equivalent to 20 cords.
- Twenty percent of a cord of wood may be bark. Bark, wastewood and pulping liquors provide more than half the United States' energy needs.

- Producing one ton of lumber uses 430 kilowatt hours of electricity or its equivalent. Turning out one ton of aluminum, by contrast, requires 17,000 kilowatt hours.

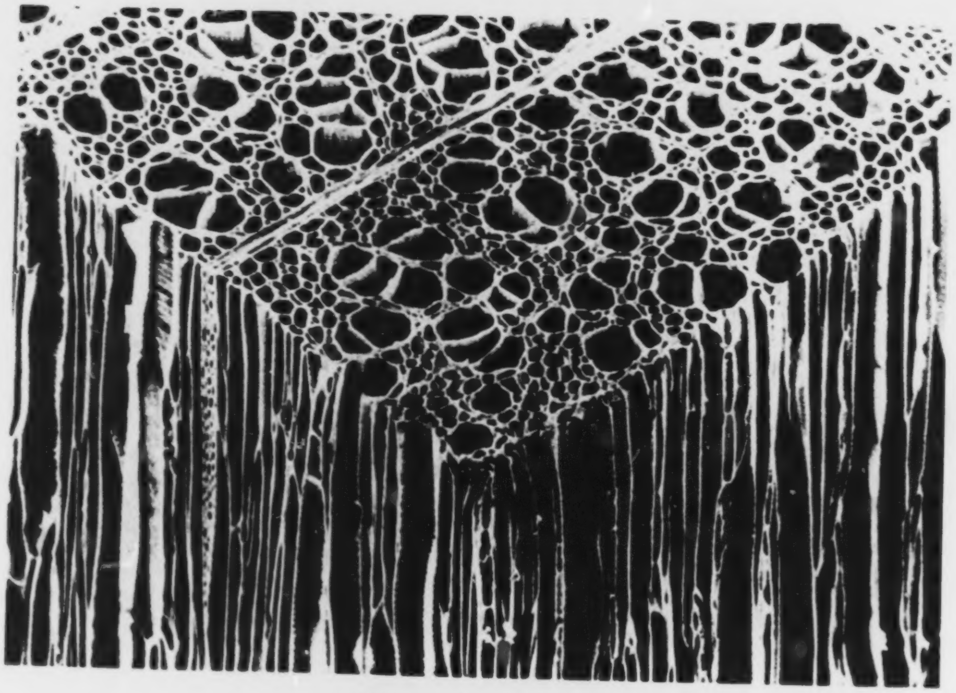
U.S. Forest Industry

	Lumber & Solid Wood	Paper	TOTAL
Value of Products Shipped	$54.679 billion	$94.814 billion	$149.493 billion
Payroll	$10.353 billion	$14.885 billion	$25.237 billion
Number of Employees	643,100	612,900	1,256,000

Used with permission of *The American Tree Farmer.*

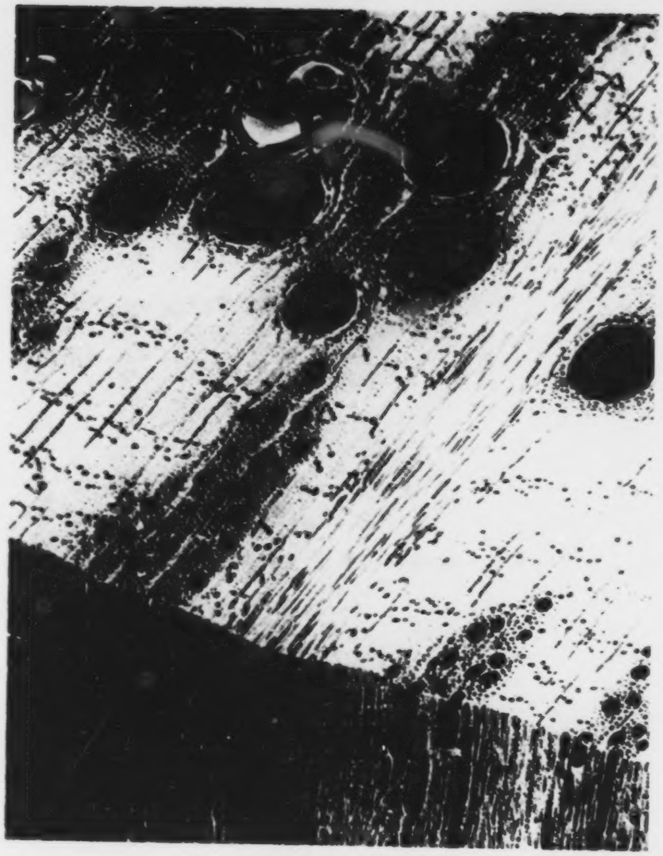
WOOD PORES AND CELLS

Hardwoods



Basswood or Linwood
Tilia americana

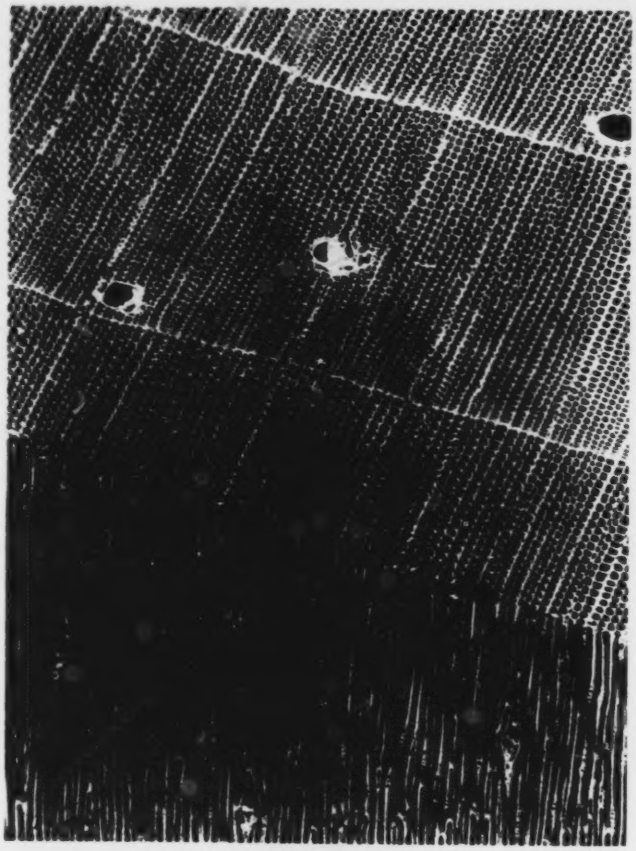
Notice the variety of cell sizes and shapes, a random order. The small cells are wood fibers. In the upper right-hand corner you can see the end of an annual ring, where the summerwood cells are closer together. Notice the ray cells across the top of the section and continuing down the side. They run from the center out to the edge. Compare the relatively regular distribution of cells in this basswood with the highly random sizes and distribution of cells in the white oak. **This is an example of diffuse porous wood.**



White Oak
Quercus alba

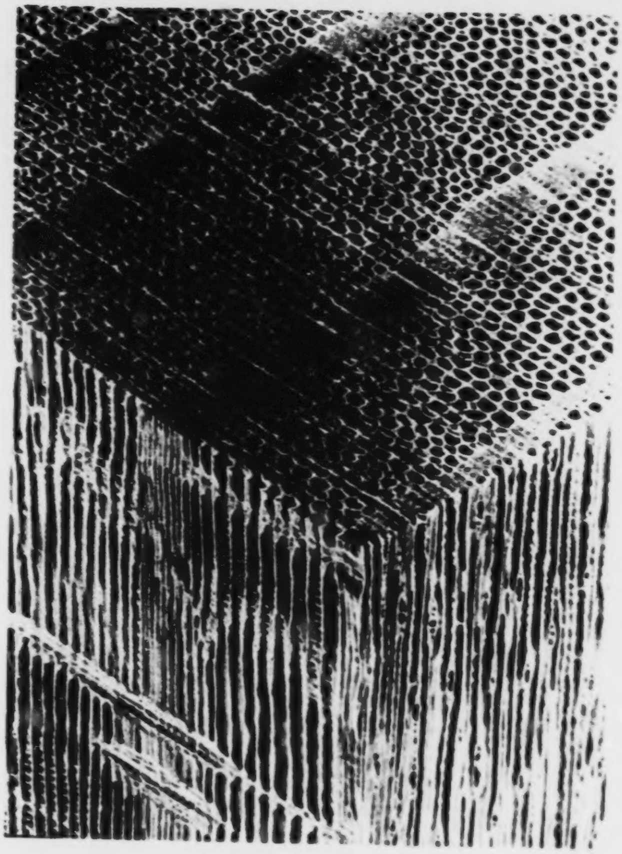
Notice the irregular size and shape of the cells. The smaller holes are summerwood and the larger holes are springwood. You can see a clear line running from the upper left corner that is the edge of the growth ring. The materials in the large cells are a crystalline substance called tyloses that plugs up the holes. Notice the large raycell running forward from the upper right hand corner and down along the side of the section. The tiniest cells are wood fibers that give white oak its strength. **This is an example of ring-porous wood.**

Softwoods



White Pine
Pinus Strobus

Notice the regularity of the cell size, shape, and spacing. The smaller, regular pattern is typical of softwoods. The lines are the ends of growth rings. Notice that the cells get slightly smaller and closer together and have thicker cell walls just before the ring and then the cells are larger, more open, and thinner-walled. The large openings are resin canals surrounded by compressed cells. The resin rises through the column and forces the cells above it aside, forming an outside ring. On the side of the sample, you can see the tear-drop shaped resin cells that run across the wood. **This is an example of non-porous wood.**



Shortleaf Pine
Pinus echinate

Again, notice the regularity in size, shape and pattern in this pine. The thick lines are summerwood cells. Compare the cell size on the vertical face of the sample. The summerwood is very dense. Shortleaf pine is a hard pine.

Photos courtesy of OSU Forestry Department.

LOSS OF THE TROPICAL RAIN FOREST

Tropical hardwood forests are felled, burned and removed to plant crops, including other species of trees. Brazil uses timber as a resource; forest land is now being sold so large landowners can own unlimited amounts of land.

Much of the forest is converted to agriculture as slash-and-burn farming. The trees are cut and burned, then the area is planted with crops. The burning increases carbon-dioxide levels in the atmosphere and the absence of trees and roots creates erosion problems especially if there is little new growth or reforestation.

As you know, the rain forests affect the oxygen level, moisture level, temperatures, and wind patterns of the entire planet. Their loss is a serious environmental issue.

The destruction of tropical rain forests is also an economic issue. Trees, used primarily for heat and fuel, are not as valuable as land for planting crops. Topsoil is shallow and fertile for only a few years because crops and rains leach important nutrients out of the soil. When crops are planted on slopes, the shallow soil quickly washes away with the heavy rains. Farmers then have to cut more trees to make more soil available. It washes away or becomes infertile and the cycle is repeated.

The farmers don't like to clear the forest. They take out the trees, not by choice, but out of necessity, to grow root crops. Land developers cut the trees to make a profit.

Interestingly, the United States experienced the same kind of massive clearing early in our history. Forest management and reforestation helped conserve and create new growth.

Two solutions have been suggested: To develop forests more intensively in America, Europe, Asia, and elsewhere; and to encourage economic reform in these countries—provide agricultural and economic alternatives so they would keep their forests.

TYPES OF WOOD, THEIR CHARACTERISTICS AND USES

Southern Pine (Yellow Pine)

Includes shortleaf, loblolly, slash, and longleaf pine. Yellow pine is another term often used to apply to these woods. Generally straight-grained, strong, fast growing.

Framing, interior finish, flooring, sheathing, crates, boxes, decking in railroad cars, etc. Much of the material goes into dimension lumber sold by retail lumber yards. Since the wood takes preservative treatment readily, it is used extensively for poles, pilings, fence posts, cross ties, treated foundation timbers, and other construction materials. Southern yellow pine also supplies much of the raw material for pulpwood industries in the South.

Ash

White in color, straight-grained, possesses high-strength properties for its weight.

Baseball bats, polo and hockey sticks, playground equipment, skis, tennis rackets, etc.; the best wood for handles for shovels, rakes, and other long-handled tools; used in construction for trim, doors, interior paneling, etc.; bentwood parts.

Beech

Hard, strong, tough, and light in color. The bark maintains an unbroken, light gray surface throughout its life.

Major use is flooring; also furniture, carpenter tools, truck body parts, toys, wooden ware, and novelty wares.

Black Cherry

Grain is reddish-brown and yellow, moderately heavy, hard, strong, fine-grained, and does not warp or split in seasoning. With the exception of black walnut, cherry lumber has a greater unit value than any other hardwood in the eastern United States.

Blackgum (Tupelo)

Very tough, cross-grained, not durable in contact with the soil, hard to work, and warps easily; grain is light, brownish-gray and white.

Basket veneer, box boards, and paper pulp.

Black walnut

Straight grained, easily worked with tools, stable; heavy, hard, strong, stiff and has good resistance to shock; wood varies from light to dark brown.

Furniture, architectural woodwork, decorative panels, cabinets, gunstocks.

Bois d'arc/bodark (Osage orange)

Extremely hard, tough but flexible, coarse-grained; heavy, durable, strong; strength and beauty increases with age; heartwood is bright orange, turning dark on exposure; sapwood is thin and pale yellow.

Fenceposts, railroad ties, cabin supports, pulleyblocks, important specialty market in manufacturing archery bows.

Catalpa

Rather soft, light, coarse-grained, and durable in contact with the soil; rarely found in sawlog size.

Fence posts, poles, and fuels, and occasionally for railroad ties.

Cottonwood

Soft, light-weight, warps easily upon drying, generally white in color.

Shipping containers, pallet lumber, paper production, furniture, agricultural implements, fences, matches.

Cypress

Light, soft, easily worked, grain is a strong contrast of dark-brown and light color; naturally resistant to termites.

Exterior trim of buildings, greenhouse planking, boat and ship building, shingles, posts, piles, and crossties. Lower grades of boards used for fencing.

Eastern red cedar

Distinctively red in color, aromatic, soft, strong, and of even texture; durable in contact with the soil.

Posts, poles, and rustic work; cedar chests, closets, and interior woodwork.

Elm

The wood is heavy, hard, strong, durable, and takes polish well.

Barrels, fencing, crossties, fuel, boats, and furniture.

Hackberry

Heavy, rather soft, weak, and decays easily when exposed; creamy white in color, ring-porous, and uniform in texture.

Furniture and veneer, fuel, and occasionally lumber.

Hickory

Heavy, hard, brittle; grain is reddish brown and white; has a pleasing grain pattern.

Hard, strong, close grained, and brown in color.

Tools and short handles; agricultural implements, sports equipment, and veneer.

Furniture, especially cabinet woods; and flooring; decking in railroad cars, trailer parts, and softball bats.

Holly

Light, tough; white when cut, but turns brown when aged.

Cabinet making, interior finish, veneer, and fancy inlays; dyed and used as a substitute for piano key ivory.

Prized for furniture; uses include interior trim and paneling.

Magnolia

Soft, fine-textured, with straight grain; grain is yellowish-brown and white.

Interior trim, paneling, and doors; milled wood goes into furniture; venetian blinds, veneer, and fuel.

201

Maple, silver (soft)

Soft, weak, close-grained, even-textured, and light brown in color.

Paneling, toys, cabinets, shipping containers, and wooden ware.

Maple, sugar (hard)

Fine, uniform texture; heavy, strong, stiff, hard, resistant to shock, generally straight grained, but also occurs as "birdseye," "curly," and "fiddleback" grain; white with a slight reddish-brown tinge.

Lumber, veneer, crossties, pulpwood; flooring, furniture, boxes, pallets, crates, handles, spools for thread.

Oak

Many species and varieties of oak are known and widely used. Wood is heavy, durable, hard, close-grained, and light to dark brown in color; durable in contact with the ground.

Universal wood used for many purposes, especially flooring and railroad ties; also used for furniture, millwork, fence posts, veneer, fuel, ship building, construction, etc.

Pecan (Pecan hickory)

Heavy, tough, hard, strong, usually shrinks considerably in drying; wide, white or nearly white, sapwood and darker heartwood.

Tool and implement handles, flooring, furniture veneer and decorative paneling; lower grades used in pallets.

Persimmon

Hard, dense, strong; grain is brown or black and white or yellowish.

Loom shuttles, golf club heads, and similar special uses.

Sweetgum

Moderately hard, close-grained, and not durable in weather exposure; uniform texture prized by cabinet makers; has a lustrous satin, reddish-brown cast.

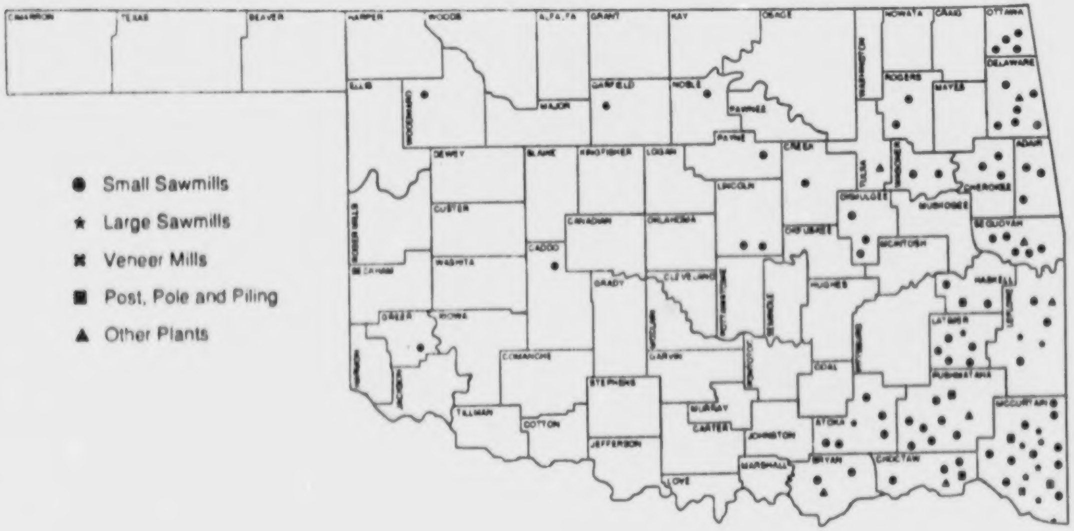
Flooring, interior finish, paper pulp, and veneers for baskets of all kinds.

Sycamore

Fairly hard, stiff, and strong; pink in color.

Furniture and furniture parts, butcher blocks, tobacco boxes, interior finish, and pallets.

PRIMARY WOOD-USING MILLS IN OKLAHOMA


● Small Sawmills
★ Large Sawmills
✖ Veneer Mills
■ Post, Pole and Piling
▲ Other Plants
CIMARRON
TEXAS
BEAVER
HARPER
WOODS
ALFALFA
GRANT
KAY
OSAGE
NOWATA
CRAIG
OTTAWA
DELAWARE
ROGERS
MAYES
ELLIS
MAJOR
GARFIELD
NOBLE
PAWNEE
PAYNE
CREEK
DEWEY
BLAINE
KINGFISHER
LOGAN
LINCOLN
ADAIR
CHEROKEE
OKMULGEE
MUSKOGEE
SEQUOYAH
CUSTER
CANADIAN
OKLAHOMA
OKFUSKEE
McINTOSH
CADDO
WASHITA
BECKHAM
GRADY
CLEVELAND
HUGHES
HASKELL
LATIMER
GREER
KIOWA
COMANCHE
GARVIN
COAL
PUSHMATAHA
STEPHENS
MURRAY
CARTER
JOHNSTON
ATOKA
McCURTAIN
TILLMAN
COTTON
JEFFERSON
MARSHALL
BRYAN
CHOCTAW
LOVE

Courtesy of USDA.

SOLID WOOD PRODUCTS

Wood is preferred for building because of its light weight, relatively low cost, aesthetic value, insulating properties, its strength and workability, resistance to heat, and elasticity. Elasticity is important because in high winds and earthquakes, wood frameworks will yield and regain their shape without damage to the general structure when brick, glass, and concrete will be damaged.

BUILDING MATERIALS

Ready-built roof trusses and other parts

Framing

Flooring

Wall coverings

Veneer

Plywood

Insulation board

Hardboard

Particle board

Interior and exterior trim

Sandwich materials

Laminated timbers for making arches and curved wood pieces

Roofing shingles and shakes

Garden decor and decks

PAPERS

Made from pulp and cellulose

Printing and writing paper

Cardboard

Linerboard (the facings on corrugated cardboard)

Newsprint

Wrapping papers

Tissue

Packing and industrial papers

Roofing felt, ceiling tile, drums and cans, paper overlays on boards or panels to make a smooth surface, electrical material, brown paper bags

Tablecloths, napkins, towels, etc.

Disposable diapers

Car engine oil filters

Speaker cones

Alarm clock cases and clockfaces

FURNITURE

Because it conducts heat slowly, wood furniture is pleasingly warm to touch. It is lightweight and takes paint, stain, and varnish for a beautiful, rich finish.

RAILROAD USES

Bridges

Snow fences

Freight cars

Ties

Building construction

SHIP BUILDING

Today's large ships are not built of wood. Wood is often used extensively in smaller boats, schooners, racing boats and sailboats.

POLES AND POSTS

The strength, elasticity and electrical insulating properties make wood a good material for carrying utility lines

Powerline poles

Wood pilings for bridges and dams

Mine timbers

Wood fence posts

Landscape timbers

CHARCOAL

COKE - A type of charcoal, used in making steel and other metal products

FARM SUPPLIES

Electrical chicken brooders

Sanitary poultry feeders

Fruit crates

FOODS

Pecan production in Oklahoma brings in $15-20 million annually. Peach production adds another $3 million to Oklahoma's agricultural income.

Nuts: Pecans, black walnuts, hickory nuts, butternuts, beechnuts, pinion nuts

Fruits: Apples, peaches, pears, oranges, persimmons, mulberries, elderberries, crabapples

Flavorings: Wintergreen, sassafras tea, sarsaparilla (root beer flavor)

CHRISTMAS PRODUCTS

Trees

Boughs

Leaves

Mistletoe

MISCELLANEOUS

Pencils

Decorations

Tool handles

Game pieces

Piano keys

Sports equipment

Baskets

Barrels

Twine and cord

CHEMICAL PRODUCTS FROM WOOD

Wood fibers are very small. In the needle-leaved trees they are about 1/7th of an inch long and 7/1,000 of an inch thick. In broadleaved trees they are even shorter. Every fiber is almost pure cellulose, and the fibers are bound together tightly by a strong sheath of lignin.

Cellulose Products

Cellulose is a very complex substance that can be separated and reassembled into cellulose products and made into other useful materials.

By altering the cellulose molecule, we can make plastics that can be spun into fabrics or molded into almost any shape.

Products made from cellulose derivatives:

- Rayon
- Photographic film
- Smokeless gunpowder
- Tire cord
- Cellophane tape
- Telephone parts
- Plastic housewares
- Plastic toys
- Foods
- Traffic signs
- Vacuum cleaner parts
- Combs
- Edge moldings on cabinets
- Eyeglass frames
- Shoe coverings
- Fabric coatings
- Plastic pipe
- Sheets, towels and blankets
- Lamp shades

Lignins, Oils, and Other Extractives

A tree is about 50% cellulose and between 20% and 30% lignin, a cementing material between the cellulose units. The rest of the wood in a tree consists of extractives and various carbohydrate materials. Extractives are materials, like those that give the red color to redwood, that can be soaked out with water or other solvents.

Lignin

Used as a dispersing agent in concrete

Storage batteries

Vanilla flavoring (vanillin)

Linoleum

Adhesives

Oils and other extractives

Also called naval stores - turpentine and rosin products

Turpentine — Used in paint, varnish, polishes, wax, pharmaceuticals, brush cleaners

Pine oil — Used in processing lead, zinc, and many other minerals; processing wool, cotton and rayon for dyeing; for processing rubber; also used in commercial laundering and in making soaps, insecticides and disinfectants

Rosin — Used in making paper, soaps, paint, varnish, inks, synthetic rubber and other products

Tannin — Used in dyes, processing hides into leather, fishing nets, inks, oil well drilling mud and medicines

Other extractives — Used in plaster, flypaper, chewing gum, ointments, salves, gasoline, deodorants, flavorings, fabric dyes

Pharmaceuticals — Drugs and medicines

Sugars

Chemical conversion offers the possibility of using the edible sugars from wood as food, making a wide range of industrial chemicals, and growing yeasts that can be used as sources of protein, fats, and vitamins.

Wood sugars are used for making alcohol, vitamins, synthetic rubber, maple sugar and syrup

RECYCLING

Many people and professions earn a living from the vast amount and variety of natural resources that the earth offers. Natural resources are important both economically and environmentally. As professionals in a field that deals with natural resources and as consumers we should become aware of ways to conserve our natural resources.

In forestry, good management can help ensure that our forests continue to produce timber and that the forest environment is sustained. But we, as consumers, can do much to contribute to conserving our natural resources.

Recycling is one positive step that some companies and individuals have taken. Many wood products can be recycled: newspaper, typing paper, cardbord, etc. Companies can use recycled paper to make products such as stationery, napkins, paper towels, and many other products.

Consumers can help conserve our natural resources by a variety of methods:

- Save recyclable-wood products and take them to recycling centers.
- Use reusable grocery bags instead of paper sacks.
- Shop wisely. Buy products in packaging that can be recycled, little or no unnecessary packaging, and are packaged in recycled products.
- Be aware of your daily use of wood products.
- Stay informed on current environmental issues.
- Speak out and become involved in efforts to conserve.

HOW BIG IS A BIG TREE?

TOOLS

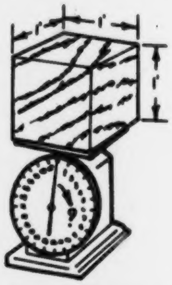
- Measuring tape or 15-foot string
- Stick about 1 foot long
- 2 people
- Polaroid camera

PROCEDURE

1. Tie the string to the stick.
2. Find an open area.
3. Measure 15 feet of string or 15 feet on the tape.
4. One person stands in place, holding the end of the string.
5. The other person makes a circle with a 15-foot radius, marking the ground with the stick.
6. When you are finished, you have a 30-foot diameter circle, the size of a giant sequoia.
7. See how many people you can get into the circle and write it down.
8. Take a picture. (This works better if the photographer is up high enough to get the whole picture from overhead.)
9. Mark the beginning and end of a 300-foot length (20 lengths of the 15-foot string).
10. Get a group of people to line up shoulder-to-shoulder, stretching out their arms and touching hands, or lying down on the ground as if standing on one another's shoulders.
11. Write down how many people it takes to reach the height of a redwood tree.
12. Take a picture.

TEST WOOD CHARACTERISTICS FOR HARDWOODS AND SOFTWOODS

- Specific gravity — Float same-sized pieces of a hardwood and a softwood in the same amount (volume) of water and observe the difference in how high they float in the water.
- Weight — Weigh same-sized pieces of a hardwood and a softwood. Weight can also be used to determine density of wood, known as weight per cubic foot



The density of wood as measured by weight per cubic foot.

Weight

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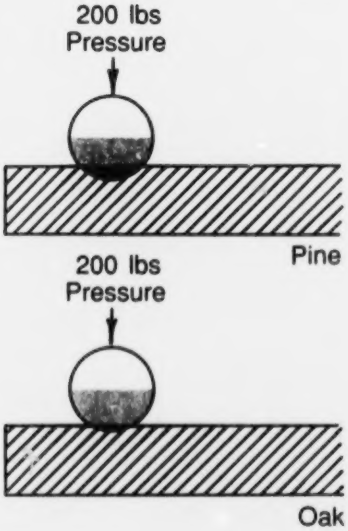
- Hardness — Hardness is measured by the amount of force required to imbed half of a steel ball with a diameter of .444" into the wood surface. You can test the hardness by driving same-size nails, hitting with a hammer and observing the dent, or placing a metal ball on the wood with a metal plate on top of it and applying 200 lbs of pressure to the plate, keeping it balanced on the ball.



Hardness

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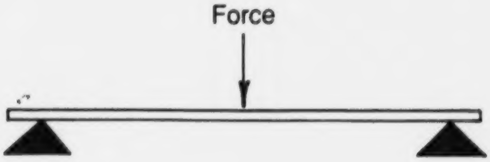
- Stiffness — The resistance of a piece of wood to bending. Place a piece of 2 x 4 or 1 x 4 hardwood and softwood between two end pieces such as concrete blocks, chairs, tables, etc. Apply a weight, such as a concrete block or pressure by leaning on the board. Measure the amount of bend in the wood as weight or pressure is applied.



Stiffness

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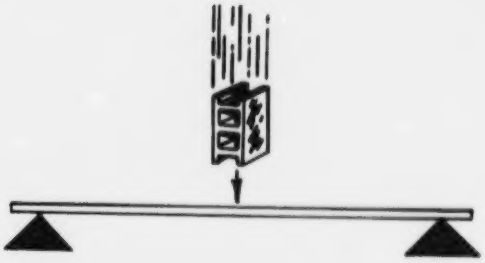
- Shock resistance - Also called impact bending; resistance to a load suddenly applied. Set hardwood and softwood boards between two end pieces and drop a load onto the board. Observe how much bending, cracking, or breaking occurs in each type of wood.



Shock Resistance

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CLASS PROJECTS FOR LEARNING ABOUT WOOD PRODUCTS

MAKE A COLLAGE ABOUT WOOD PRODUCTS

Using pictures from magazines and newspapers, cut out pictures of wood products and glue them on poster board. Words related to wood and wood products can be included.

MAKE A MAP OF LOCAL FORESTS AND FOREST PRODUCTS PROCESSING PLANTS

On a large piece of poster board or on your class bulletin board, draw a map of your county and surrounding counties. Locate major forest areas, using aerial maps or information from your local extension agents. List or paste on pictures of wood products produced in your area and the name of the mill or manufacturing plant.

MAKE A "BEFORE AND AFTER" DISPLAY

Use two pieces of each type of wood. Sand and varnish one so the grain shows and display them next to each other. Label them, including their uses and characteristics.

MAKE PAPER FROM RAW MATERIALS

TOOLS AND MATERIALS

- Materials from OFA Paper-Making Kit, or
  - Wet pulp
  - Large sponge
  - Two small sponges
  - One wire screen, 4" x 4"
  - One forming ring, 1/8" plywood cut to 4" x 4" with a 3" hole in the center
  - Two pieces of blotter paper, 4" x 4"
  - Pressing blocks, 1/8" plywood cut to 4" x 4"
- Tablespoon
- Quart jar with tight-fitting lid, filled with 1 qt of water
- Shallow baking pan
- One-cup liquid measuring cup
- Household electric iron
- Smooth, hard surface for ironing

PROCEDURE

1. Remove a tablespoon full of wet fiber from the container, or enough to make a ball about one inch in diameter.
2. Place fiber in the quart of water.
3. Shake until the fiber is completely dissolved and set aside.

   NOTE: The quart should make 3-4 pieces of 3" paper.
4. Place the large sponge in the shallow pan.
5. Lay the wire screen flat on top of the sponge.
6. Place the donut shaped forming ring on top of the wire screen.

7. Shake the quart jar and measure out one cup.

8. Pour the solution from the measuring cup slowly and carefully, a little at a time, onto the screen.

   NOTE: You will see the water go through the screen and the tiny fibers matting together.

9. Lay out two pieces of blotting paper, side by side.

10. Remove the forming ring and pick up the screen.

11. Place the screen between the two small sponges as if making a sandwich.

12. Press the sponges together gently until all excess water is absorbed into the sponges.

13. Remove the sponges and **carefully** lift off the wet, thin sheet of paper from the screen.

14. Place the wet sheet of paper on one piece of blotting paper.

15. Place the second piece of blotting paper on top, sandwiching the new paper between them.

16. Place the blotter sandwich between the two solid square pieces of wood; hold for 15 seconds.

17. Remove the blotting paper and set it aside to dry.

    NOTE: Blotting paper can be reused.

18. Turn on iron to medium-warm (synthetic fabrics) setting.

19. Gently press the sheet dry, without moving the iron, until dry and crisp.

    NOTE: Moving the iron can tear the paper.

20. Have your instructor check your work.

21. Put away tools and materials and clean the work area.

ASSIGNMENT SHEET 1

IDENTIFY FORESTS AND FOREST PRODUCTS

III

NAME ______________________________ SCORE _______

OBJECTIVE 10

Make a collection of wood.

INTRODUCTION

Many people who go to the lumberyard order boards or plywood, usually pine. They may not know that a different kind of wood might be stronger, more resistant to moisture, or prettier for the project they're working on. Knowing and recognizing the characteristics of woods makes us more aware of the world around us and makes us better able to select wood for our own uses.

DIRECTIONS

Make a collection of different types of wood. Your instructor will provide samples from lumberyards and sawmills and will tell you how many samples you must have in your collection.

Tape or glue the wood onto strong paper. Write a description of the wood and its uses. Strive to be neat and to express yourself clearly. Use the information in Supplement 4 to write in:

- The name of the wood
- The characteristics, including a description of your own observations and knowledge about the wood, such as the grain pattern, smell, color, etc.
- The uses and products

Hint: As you write about the product, look around and try to identify it in your school or home.

EXAMPLE: **Name** SILVER MAPLE

Characteristics

Structure: Soft, weak, close-grained, even-textured

Color: Light brown

Maple veneer finishes to a rich color and the grain has a lot of variety. Maple is a pretty wood. It adds a feeling of richness to a room.

Uses and products

Furniture, paneling, toys, cabinets, shipping containers and woodenware

ASSIGNMENT SHEET 2

IDENTIFY FORESTS AND FOREST PRODUCTS

III

NAME ______________________________ SCORE _______

OBJECTIVE 11

Identify wood products.

INTRODUCTION

More than 5,000 products in our everyday lives come from or contain wood or substances, such as oils, that come from wood. Wood is used in so many items and in so many different ways that no one has succeeded in making a complete list.

Look around you, and you'll see hundreds of items that you've never realized are actually wood products.

DIRECTIONS

Identify wood products in the following categories. Use Supplements 6 and 7 on wood products to help you recognize wood items found around you.

1. Identify 25 wood products visible and not visible in your classroom.

   EXAMPLES: A visible wood product would be a desk. A not visible wood product would be a 2 x 4 inside the wall.

2. Identify ten items made from wood that don't look like wood.

____

____

____

____

____

____

____

____

____

____

3. Go through three rooms of your house and find 10 items containing wood in each room. Write the name of the room and you ten items.

   Hint: Check the garage or shop area and cleaning supplies storage area.

   Room #1 ______________

____

____

____

____

____

____

____

____

____

____

____

____

Room #2 ______________________

Room #3 ______________________

ASSIGNMENT ANSWERS

IDENTIFY FORESTS AND FOREST PRODUCTS

III

ASSIGNMENT SHEET 1

Check that student has included the minimum number of samples assigned.

Check Supplement 4 for accuracy of characteristics and uses.

Check for neatness and clear expression.

ASSIGNMENT SHEET 2

Check that answers are complete and appropriate

1. 25 items found in your classroom
2. 10 items that don't look like wood
3. 10 items found in each room

NAME ______________________________ SCORE ________

OBJECTIVE 1

Match terms associated with forests and forest products to their correct definitions. Write the correct letters in the blanks.

____ 1. The direction of alignment and arrangement of wood structures

____ 2. The art of producing and tending a forest; controlling the forest establishment, composition and growth

____ 3. The weight of a substance compared with the density of distilled water.

____ 4. Size and amounts of woody elements

____ 5. Anything produced in the course of making something else

____ 6. Wood cut or prepared primarily for processing into wood pulp for later manufacture into paper, fiberboard or other products

____ 7. Losing leaves in the winter

____ 8. Tiny openings in the surface through which air or fluids can be absorbed or discharged

____ 9. Trees that yield logs suitable in size and quality for the production of lumber

___ 10. A thin sheet of wood used for plywood and decorative furniture surfaces

___ 11. Sheets of construction wood made of three or more sheets of veneer glued together, with the grain of successive sheets laid crosswise

___ 12. Renewal of the forest by self-sown seeds, sprouts, roots, etc.

___ 13. Cone-bearing, needle-leaved tree

a. Texture
b. Pores
c. By-product
d. Natural regeneration
e. Silviculture
f. Broadleaved
g. Specific gravity
h. Plywood
i. Grain
j. Pulpwood
k. Millwood
l. Deciduous
m. Veneer
n. Wood pattern
o. Sawlogs
p. Subsidiary
q. Management
r. Conifer
s. Restocking

OBJECTIVE 2

Distinguish between softwoods and hardwoods. Write an "S" in the blanks before characteristics of softwoods and an "H" in the blanks before characteristics of hardwoods.

____ 1. Open-grain, having a porous cell structure

____ 2. Evergreens

____ 3. Conifers

____ 4. Usually deciduous (lose their leaves in winter)

____ 5. Includes oaks, ashes, birches, maples, and others

____ 6. Close-grain, having close-knit and nonporous cell structure

____ 7. Includes pines, spruces, and firs

____ 8. Broadleaved trees

OBJECTIVE 3

List characteristics of forest areas of the world. Write at least four characteristics for each forest area.

- Tropical rain forest

____

____

____

____

____

____

- Temperate hardwood forest

____

____

____

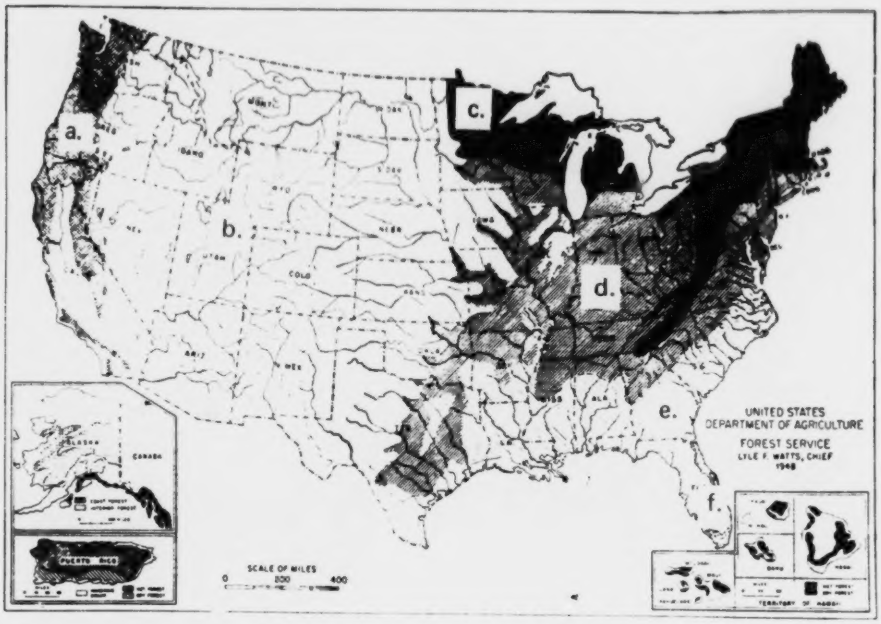
____

____

____

- Coniferous forest

OBJECTIVE 4 **Identify forest regions of the United States on a map.** Write the correct names in the blanks.


a.
b.
c.
d.
e.
f.
UNITED STATES
DEPARTMENT OF AGRICULTURE
FOREST SERVICE
LYLE F. WATTS, CHIEF
1948
SCALE OF MILES
0
200
400
PUERTO RICO
TERRITORY OF HAWAII

a. ____________

b. ____________

c. ____________

d. ____________

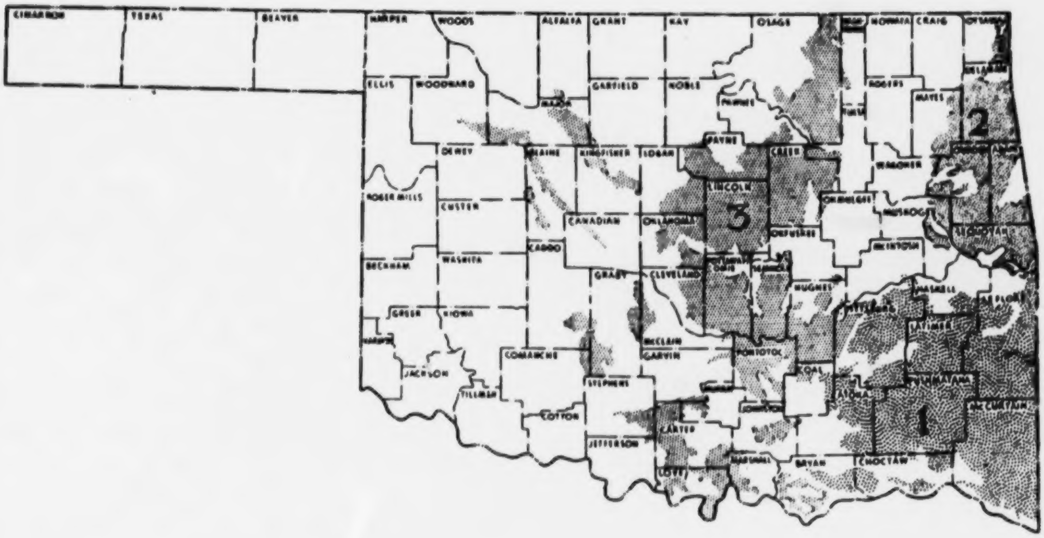
e. ____________

f. ____________

OBJECTIVE 5 | **List one evergreen and one broadleaf tree from each region.**

Region name	Evergreens	Broadleaf trees
Pacific Coast		
Rocky Mountain		
Tropical		
Southern		
Central Hardwood		
Northern		

OBJECTIVE 6 | **Name the principal species associated with forest regions of Oklahoma.**


CIMARRON
TEXAS
BEAVER
HARPER
WOODS
ALFALFA
GRANT
KAY
OSAGE
NOWATA
CRAIG
OTTAWA
ELLIS
WOODWARD
MAJOR
GARFIELD
NOBLE
PAWNEE
ROGERS
MAYES
DELAWARE
TULSA
2
PAYNE
DEWEY
BLAINE
KINGFISHER
LOGAN
CREEK
WAGONER
ROGER MILLS
CUSTER
LINCOLN
3
CANADIAN
OKLAHOMA
OKMULGEE
MUSKOGEE
OKFUSKEE
SEQUOYAH
McINTOSH
BECKHAM
WASHITA
CADDO
GRADY
CLEVELAND
POTTAWATOMIE
SEMINOLE
HUGHES
HASKELL
LE FLORE
GREER
KIOWA
PITTSBURG
LATIMER
HARMON
McCLAIN
GARVIN
PONTOTOC
JACKSON
COMANCHE
COAL
ATOKA
PUSHMATAHA
TILLMAN
STEPHENS
JOHNSTON
1
McCURTAIN
COTTON
CARTER
JEFFERSON
MARSHALL
BRYAN
CHOCTAW
LOVE

REGION 1 ______________________________

REGION 2 ______________________________

REGION 3 ______________________________

OBJECTIVE 7 | **Select from a list physical properties of wood important to wood uses.**

____ 1. Specific gravity or weight

____ 2. Color

____ 3. Grain

____ 4. Texture

____ 5. Strength

____ 6. Width of bark

____ 7. Stiffness

____ 8. Bending

____ 9. Hardness

___ 10. Age

___ 11. Odor

___ 12. Toughness

___ 13. Ability to be stained

___ 14. Taste

___ 15. Chemical properties

OBJECTIVE 8

Choose the best word or phrase to complete statements about forest production. Write the correct letter in the blank.

____1. Planning and management.

a. occur at the beginning of a project

b. are the most expensive parts of the operation

c. are on-going activities

d. are a permanent outline of objectives

____2. Small logging operations.

a. do completely different work from large companies

b. are less reliable than large companies

c. can perform essentially the same work as large companies

d. usually do thinning and rarely harvest an entire crop

____3. The number of products manufactured from wood is about.

a. 3,000

b. 5,000

c. 8,000

d. 10,000

____ 4. Reforestation is.

a. minimally important

b. defined as planting seedlings

c. accomplished by reforestation contractors

d. the final step in the forest management program

____ 5. Thinning is a practice.

a. performed to meet consumer demand

b. required by law

c. of management for high-profit performed every 10-12 years

d. of cutting certain trees in an immature stand to increase the rate of growth in the stand

____ 6. Planning and management determine all EXCEPT.

a. all stages of caring for and harvesting timber

b. schedule for intermediate harvesting

c. reforestation

d. how to cull diseased or unwanted trees

e. consumer demand

f. protect trees from fire, insect, and disease damage

g. fertilize and improve soil conditions

h. selling the harvested timber

____ 7. Wood by-products are.

a. buried

b. burned

c. sold to manufacturers

d. stockpiled for times of high demand

____ 8. The process of harvesting includes all tasks EXCEPT.

a. reforestation

b. cutting timber

c. hauling timber to a yard

d. hauling timber to a mill

____ 9. The wood from thinning operations is taken for all the following purposes EXCEPT.

a. removal of less desirable trees that compete for light, air, and moisture so that the more valuable trees can thrive

b. to make the stand more aesthetically pleasing

c. to be sold for firewood if a hardwood

d. to be chipped and used as pulpwood or as posts and poles, if a softwood

OBJECTIVE 9

Arrange in order Oklahoma wood products according to their importance to the state economy. Write a "1" in the blank before the most important product, a "2" in the blank before the second-most important product, and so on.

____ Veneer

____ Pulpwood products

____ Sawlogs

____ By-products

____ Miscellaneous

____ Poles and posts

NOTICE

The following assignment sheets are not part of the written test. If these activities have not been completed, check with your instructor.

OBJECTIVE 10 **Make a collection of wood.** SCORE ________

OBJECTIVE 11 **Identify wood products.** SCORE ________

OBJECTIVE 1

1. i
2. e
3. g
4. a
5. c
6. j
7. l
8. b
9. o
10. m
11. h
12. d
13. r

OBJECTIVE 2

1. H
2. S
3. S
4. H
5. H
6. S
7. S
8. H

OBJECTIVE 3

Answer must include any four under each forest area.

Tropical rain forest

- Makes up about 50% of the entire forest area of the world
- Is the most highly complex of all the forests
- Ranges from dense jungle to small groups of trees on the grasslands
- Trees have large, evergreen leaves and varied heights up to 15-150 feet high
- May have as many as 80 species growing on a single acre
- Grows in high humidity
- Is the source of valuable tropical hardwoods such as mahogany, eucalyptus, and teak
- Grows in areas where the average temperature is about 80° F (27° C.) and temperatures never fall below 40° F (5° C.)
- Trees grow, die, and decompose quickly

Temperate hardwood forest

- Makes up about 15% of the entire forest area of the world
- A well-defined treetop level (canopy)
- Leaves are generally simple, bright green, and fall off in winter
- Forests grow in the warmer portions of the temperate zone with about 23 inches (600mm) of rainfall per year
- A large number of species grow in the hardwood forests, including oaks, beeches and other trees reaching a height of 75-100 feet (22.8-30 meters)
- Conifers are often found mixed in hardwood stands

Coniferous forest

- Makes up about 35% of the entire forest area of the world
- Is the most important in terms of usefulness and forest management
- Consists of a stand of tall, straight trunks with relatively small tops (crowns) reaching about 100 feet (30 m) high
- Trees have thick, dark evergreen needles that let very little light pass to the forest floor so the floor is a carpet of needles
- Consists of only a few species and produces the most sawlogs of all the forests
- Grows in the colder parts of the north temperate zone where average summer low temperature is about 50° F. (10° C.) and winters are cold
- Forest management is most highly developed for these forests because of the heavy use of softwood timber and the rapid growth of high-quality trees

OBJECTIVE 4

a. Pacific coast

b. Rocky Mountain

c. Northern

d. Central hardwood

e. Southern

f. Tropical

OBJECTIVE 5

Answers should include one evergreen and one boradleaf tree from each region. The Tropical region will have only broadleaf trees.

Pacific coast

Evergreens	Broadleaf trees
Douglas fir	Red alder
Ponderosa pine	Big-leaf maple
Western hemlock	Oaks
Sitka spruce	Black cottonwood
Sugar pine	
Lodgepole pine	
Noble fir	
Sequoia	
Redwood	
Incense cedar	
White fir	

Rocky Mountain

Evergreens	Broadleaf trees
Ponderosa pine	Aspen
Lodgepole pine	
Douglas fir	
Western red cedar	
Western hemlock	
Western white pine	
Engleman spruce	
White fir	
Western larch	

Tropical

Broadleaf trees

Mahogany

Bay

Mangrove

Palm

Southern

Evergreens

- Yellow pines:
  - Loblolly pine
  - Shortleaf pine
  - Slash pine
  - Longleaf pine
- Virginia pine
- Bald cypress

Broadleaf trees

- Sweetgum
- Blackgum (tupelo)
- Oaks
- Maples
- White ash
- Hickory
- Yellow poplar
- Walnut
- Cottonwood
- Pecan

Central hardwood

Evergreens

- Virginia pine
- Shortleaf
- Pitch pine
- Eastern red cedar
- Eastern hemlocks

Broadleaf trees

- Northern red oak
- Hickory
- Elm
- Red maple
- White ash
- Sycamore
- Cottonwood
- Black walnut
- Blackgum (tupelo)
- Yellow poplar
- Sweet or red gum

Northern

Evergreens

Eastern white pine
Red spruce
White spruce
Black spruce
Norway or red pine
Jack pine
Balsam fir
White cedar
Eastern hemlock

Broadleaf trees

Beech
Northern red oak
White oak
Aspen
Yellow birch
Paper birch
Black birch
Black walnut
Sugar maple
Blackgum (tupelo)
White ash
Black cherry
Basswood

OBJECTIVE 6

REGION 1—Shortleaf pine, oak
REGION 2—Oak, hickory, pine
REGION 3—Post oak, blackjack oak

OBJECTIVE 7

1, 3, 5, 7, 8, 9, 12, 13, 15

OBJECTIVE 8

1. c
2. c
3. b
4. d
5. d
6. e
7. c
8. a
9. b

OBJECTIVE 9	4, 2, 1, 6, 5, 3
OBJECTIVE 10	Refer to answers to Assignment Sheet 1.
OBJECTIVE 11	Refer to answers to Assignment Sheet 2.

OBJECTIVE SHEET

DETERMINE PATTERNS OF TREE GROWTH AND CLASSIFICATION

IV

INTRODUCTION

Learning about tree growth is the beginning of the biological sciences in forestry. Photosynthesis, the process of making food, respiration, the process of breathing, and reproduction are basic and common to all plants. All forestry science is based on these processes. In this unit you will also be learning about annual growth rings and several classification systems. Annual growth rings, built up cell by cell, are unique to trees and can tell you much more than just the tree's age.

Classification systems give us a way of talking about a subject. They are a shortcut in language so that a simple word or phrase can include a whole range of characteristics or concepts.

PREREQUISITES

None

UNIT OBJECTIVE

After completing this unit, the student should be able to recognize the major parts, processes, and classification systems of a tree, classify trees according to size and crown, identify hardiness zones, and count annual rings. The student will demonstrate these competencies by completing an assignment sheet and written test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with patterns of tree growth and classification to their correct definitions.
2. List the main parts of a tree.
3. Match parts of the tree to their functions or descriptions.
4. Select from a list true statements about tree respiration and photosynthesis.
5. Match environmental and biological factors that affect tree growth to their descriptions.
6. State the methods of tree reproduction.
7. Select from a list characteristics of tree growth.
8. Choose the best word or phrase to complete statements concerning stand classifications.
9. Name tree sizes according to size classification.

10. Match developmental stages in even-aged stands to their descriptions.

11. Label trees according to crown classification.

12. Determine amount and distribution of average annual precipitation. (Assignment Sheet 1)

13. Count annual rings to obtain information about trees. (Assignment Sheet 2)

14. Identify trees using size classifications. (Assignment Sheet 3)

15. Identify trees using crown classifications. (Assignment Sheet 4)

SUGGESTED ACTIVITIES

DETERMINE PATTERNS OF TREE GROWTH AND CLASSIFICATION

IV

PREPARATION

- Obtain materials to supplement unit.

  NOTE: See Suggested Resources.

- Review instructional outline for this unit. Modify time frames to suit class needs and plan activities for each class period.

- Study specific objectives to determine those you will cover in your presentation. Decide also which objectives should be taught to which students.

- Determine scope and sequence of objectives that you add. Design and develop support materials, including evaluation techniques, for additional objectives.

- Determine how you will schedule time for students to demonstrate competence in the required procedures.

- Invite a forester or a biologist to discuss and show slides or films on photosynthesis, respiration, and annual rings.

  NOTE: Supply speakers with specific objectives and other appropriate sections of the unit.

- If possible, obtain a microscope and green leaves to show students the stomata on the bottom of the leaf.

- Identify various stands for students to practice recognition of classification systems, even-aged and uneven-aged stands, and developmental stages.

DELIVERY

Objective 1

- Discuss terms associated with patterns of tree growth and classification.

- Lead a discussion with students about any previous experiences they have had with tree growth or classification systems.

Objectives 2 and 3

- Discuss the parts of a tree.

- Let students guess the parts of a tree before working with the text.

- Have cross sections of trees available for students to identify the parts of the stem.

- Have students complete Activity Sheet 1.

- Have students use library references to learn more about each part of the tree and its function.

- Have students gather samples of fruit, root hairs, leaves, bark, etc. and share their findings with the class.

Objective 4

- Discuss tree respiration and photosynthesis.

- Draw on students' prior knowledge about plant processes and tie these in with respiration and photosynthesis.

- Draw analogies between trees and the human body. Stress that photosynthesis is much simpler and more direct than human digestion and nutrition; and that plant respiration—the exchange of gases—-is similar to human respiration.

- Use a microscope to show students the stomata on the bottom of the leaf.

Objective 5

- Discuss the environmental and biological factors that affect tree growth.

- Draw from students' knowledge and assumptions about these factors and tie them to the subject.

- Compare trees growing in different soil and light conditions in your area to demonstrate the effects of environmental factors.

- Discuss the biological factors which affect tree growth, stressing that trees that would normally grow tall and straight, will adapt and grow as bushes in the presence of unfavorable environmental conditions.

- Have students complete Assignment Sheet 1, using Supplement 1 on rainfall.

Objective 6

- Use the Information Sheet and Supplement 2 to discuss methods of tree reproduction.
- Have students collect samples of ovaries, seed pods, seeds, and germinating seeds.
- Germinate seeds in the classroom.

Objective 7

- Discuss characteristics of tree growth.
- Explain that the whorls of limbs on Southern pines generally represent one year of growth.
- Show students cross sections of trees and discuss environmental effects on growth evident in the annual rings.
- Provide students with a weather history or stand history for a cross section of a tree and correlate rings with wet and drought conditions.
- Provide students with cross sections of three different trees for use with Assignment Sheet 2.
- Have students complete Assignment Sheet 2.

Objectives 8 through 11

- Discuss other classification systems that students already know and use their knowledge and experience to lead into tree classification systems.
- Discuss stand, size, developmental, and crown classifications.
- Arrange a field trip to view stands of various classifications.
- Select a stand of trees and mark them for use in Assignment Sheets 3 and 4, or use photographs or slides.
- Have students complete Assignment Sheets 3 and 4.

APPLICATION

Objective 12

- Use Assignment Sheet 1 to give students the opportunity to learn how to read and use rainfall maps.

Objective 13

- Use Assignment Sheet 2 to give students the opportunity to count and read annual rings.
- Let students find the year of significant events in their own lives.

Objective 14

- Use Assignment Sheet 3 to give students the opportunity to observe and learn size classifications.
- Make a practice tour so students can see the large differences in diameter of trees without measuring. If you wish, you can provide and teach students how to use diameter tapes.

Objective 15

- Use Assignment Sheet 4 to give students the opportunity to observe and learn crown classifications.

EVALUATION

Written test

- Explain to students that they will be asked to demonstrate on the written test actions listed in the specific objectives.
- Give written test.

  NOTE: The written test may be given in sections if desired.
- Evaluate students on assignment sheet activities if not previously done.
- Reteach and retest if necessary.
- Complete appropriate section of competency profiles.
- Review individual and group performance in order to evaluate teaching methods. Adjust scope, sequence, or instructional approaches for additional lessons as required.

SUGGESTED RESOURCES

Speakers

Oklahoma Natural Resources Speakers Bureau sponsored through Oklahoma State University, Division of Agriculture; Oklahoma Cooperative Extension Service - Forestry; Oklahoma Conservation Commission; and the Oklahoma Forestry Association. The bureau lists speakers on a variety of forestry-related topics. Speakers operate on a time-available basis. Request a listing of speakers, programs, slide presentations and videotapes from your local extension office or from:

Dr. Steve Anderson
Forestry Dept.
Oklahoma State University
239 Agriculture Hall
Stillwater, OK 74078
(405) 744-9431

Dave Marcouiller
Forestry Dept.
Oklahoma State University
242 Agriculture Hall
Stillwater, OK 74078
(405) 744-5444

Teachers from outside of Oklahoma should contact the Forestry Extension Office in their state.

UNIT REFERENCES

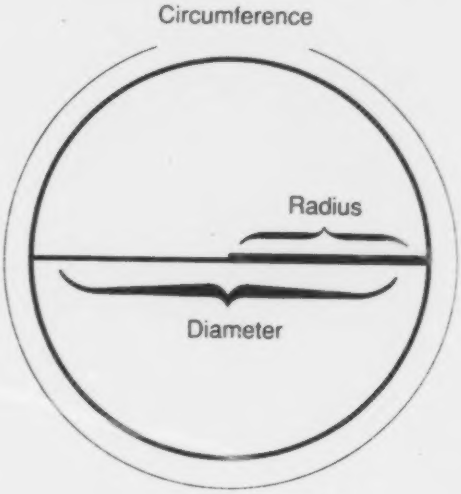
- Anderson, David A. and I. I. Holland, *Forests and Forestry*, The Interstate Printers & Publishers, Inc., Danville, Illinois, 1982.
- Collins, B. McManus, and Fred M. White, *Elementary Forestry*, Reston Publishing Company, Reston, Virginia, 1981.
- *Forest Trees of Oklahoma*, Oklahoma Forestry Division, State Department of Agriculture, Oklahoma City, Oklahoma, 1981.
- *Harvesting Forestry Products*, Texas A&M University, College Station, Texas, 1976.
- Stoddard, Charles H. and Glenn M. Stoddard, *Essentials of Forestry Practice*, 4th ed., John Wiley & Sons, New York, 1987.

INFORMATION SHEET	DETERMINE PATTERNS OF TREE GROWTH AND CLASSIFICATION	IV

OBJECTIVE 1

Match terms associated with patterns of tree growth and classification to their correct definitions.

- **Annual rings**—The layer of wood formed in a season's growth
- **By-product**—Anything produced in the course of making another thing
- **Circumference**—The distance around the outside of a circle



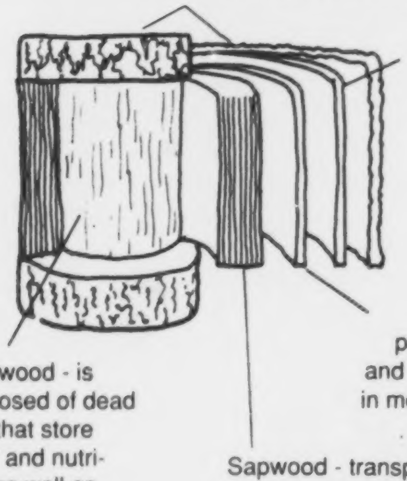
- **Closing of the stand**—When the leaves of adjacent trees touch
- **DBH (Diameter Breast Height)**—Diameter of a tree at 4 1/2 feet from the ground
- **Developmental**—Connected with steps or stages of growth
- **Dormant**—Inactive
- **Nutrients**—Minerals that promote growth and development
- **Ovary**—In the female reproductive system, the sac that holds the ovule

- **Ovule**—The part that develops into a seed
- **Photoperiod**—The duration of sunlight in a day
- **Photosynthesis**—Process of making food from water, nutrients, carbon dioxide, and sunlight
- **Respiration**—Process of breathing
- **Transpiration**—Evaporation of water through the leaves

OBJECTIVE 2 **List the main parts of a tree.**

- **Crown**—The upper portion of a tree that contains the branches and the foliage
- **Trunk**—The stem portion that supports the branches or crown
- **Roots**—The portion of the tree that extends deep into the ground to support and anchor it

  NOTE: Roots often reach about 12 feet down from the surface, but may extend as deep as 30 feet or more. Lateral roots often run 35-100 feet or more out from the trunk. Most feeding roots are usually found just below the surface.



Bark - provides protection from extreme temperatures, insects, disease and sometimes fire.

Phloem - or inner bark transports the food (sugar solution) from leaves to roots, eventually phloem becomes bark as the tree grows.

Cambium - is a thin layer of specialized cells which divide to produce new phloem to the outside and new sapwood to the inside, annually in most North American species.

Heartwood - is composed of dead cells that store water and nutrients as well as provide support for the tree.

Sapwood - transports water (sap) from the roots to the leaves. The less active interior cells gradually die and become heartwood.

Main Parts of a Tree

Used with permission of *The American Tree Farmer*.

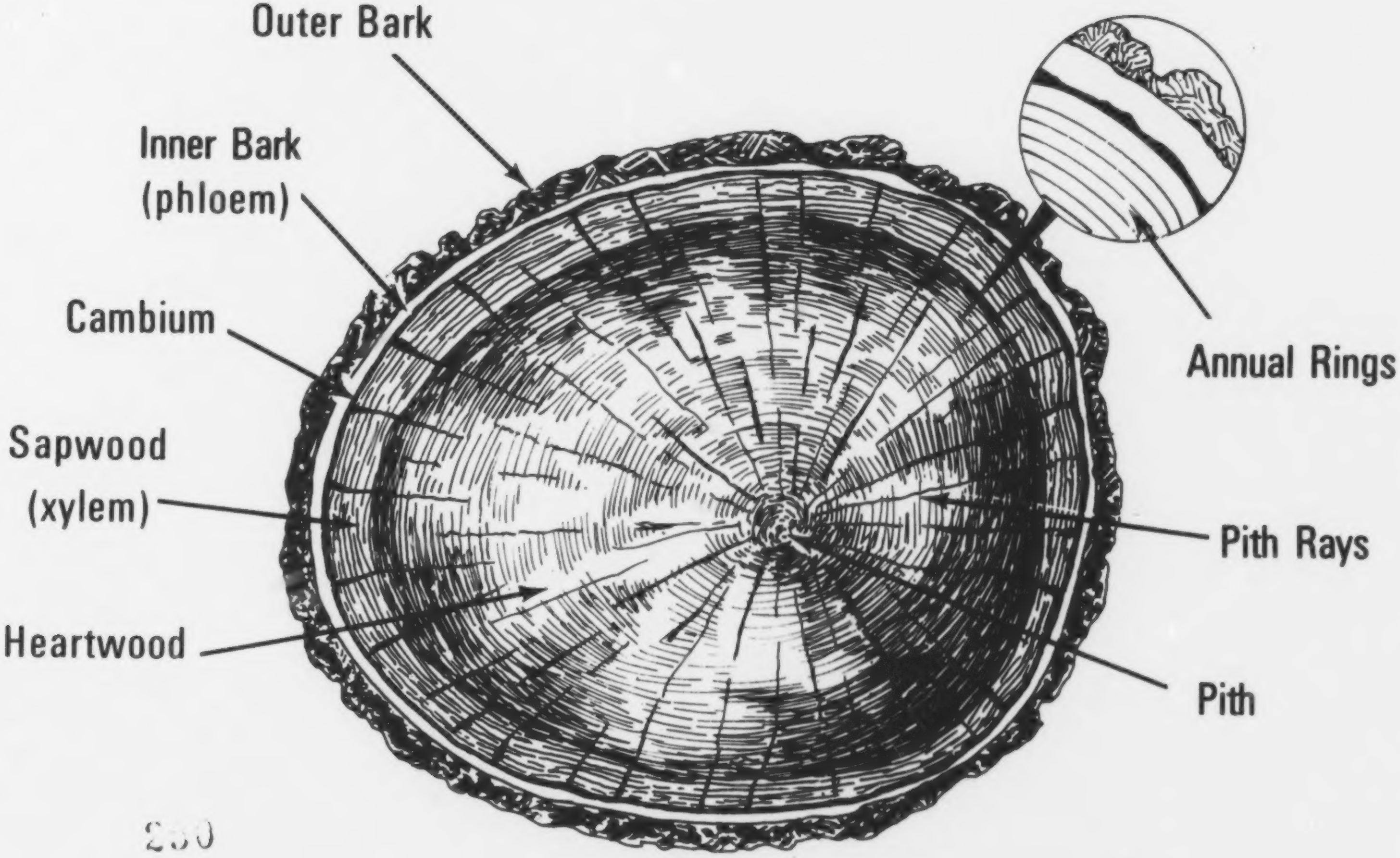
OBJECTIVE 3

Match parts of the tree to their functions or descriptions. (Activity Sheet 1)

Trunk

- **Outer bark**—Protects tree from insects, disease, excessive heat and cold and other injuries
- **Inner bark (Phloem)**—Carries sugar made in the leaves down to the branches, trunk, and roots where it is converted to other growth substances
- **Cambium**—A layer of cells between the bark and wood where growth occurs, forming annual rings of new wood inside and new bark outside
- **Sapwood (Xylem)**—Carries the sap (water plus nitrogen and mineral nutrients) from the roots to the leaves; stores food
- **Heartwood**—Dark-colored, inactive center portion that was once sapwood; gives strength to the tree to keep it upright
- **Pith**—Dark, soft, spongy center in the core of the heartwood
- **Pith rays**—A ribbon-like strand of tissue formed by the cambium and extending out across the grain

The Trunk


Outer Bark
Inner Bark
(phloem)
Cambium
Sapwood
(xylem)
Heartwood
Annual Rings
Pith Rays
Pith

Crown

- **Leaves**—Manufacture food for the tree through photosynthesis and transpiration
- **Twigs**—Current year's growth of the stem; carry nutrients between leaves and branches
- **Flowers**—Female reproductive parts of the tree
- **Fruit**—The ripened ovary of the flower, containing the seeds

  EXAMPLES: Acorns, pecans, hickory nuts

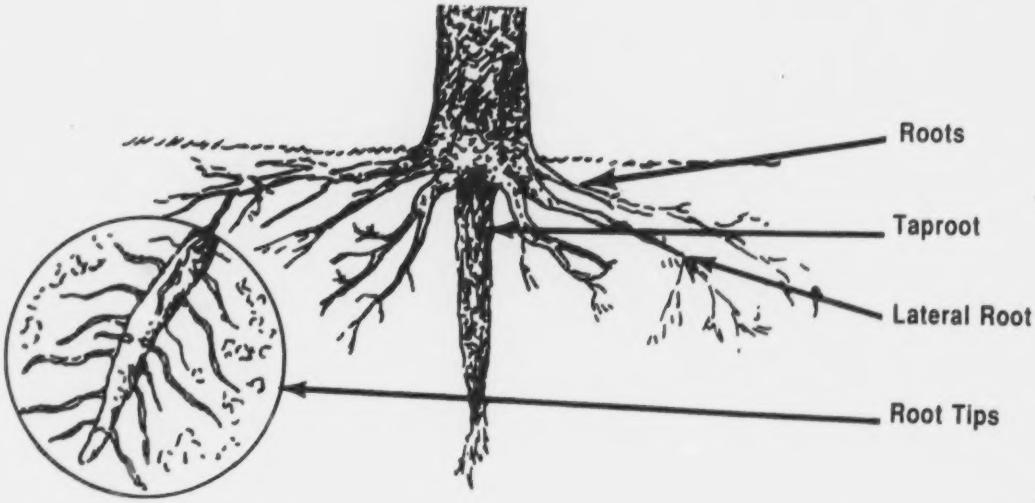
  NOTE: Hardwood (broadleaved) trees produce fruit. Conifers (needle-leaved trees) produce seeds on the scales of female cones.

Roots

- **Taproot**—Largest root of the root system; provides the main support for the tree and anchors it in the ground

  NOTE: Not all trees have a taproot.

- **Lateral roots**—Side roots of root system; help support and anchor the trunk; hold root hairs
- **Root tips or root hairs**—Take up water containing nutrients



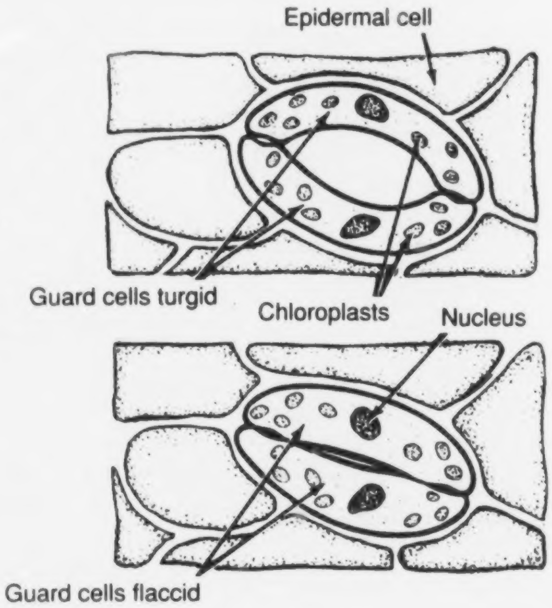
Root Parts

OBJECTIVE 4

Select from a list true statements about tree respiration and photosynthesis.

Respiration

- Trees breathe through their leaves. The underside of each leaf has microscopic pores called stomata.



Stomate Open and Closed

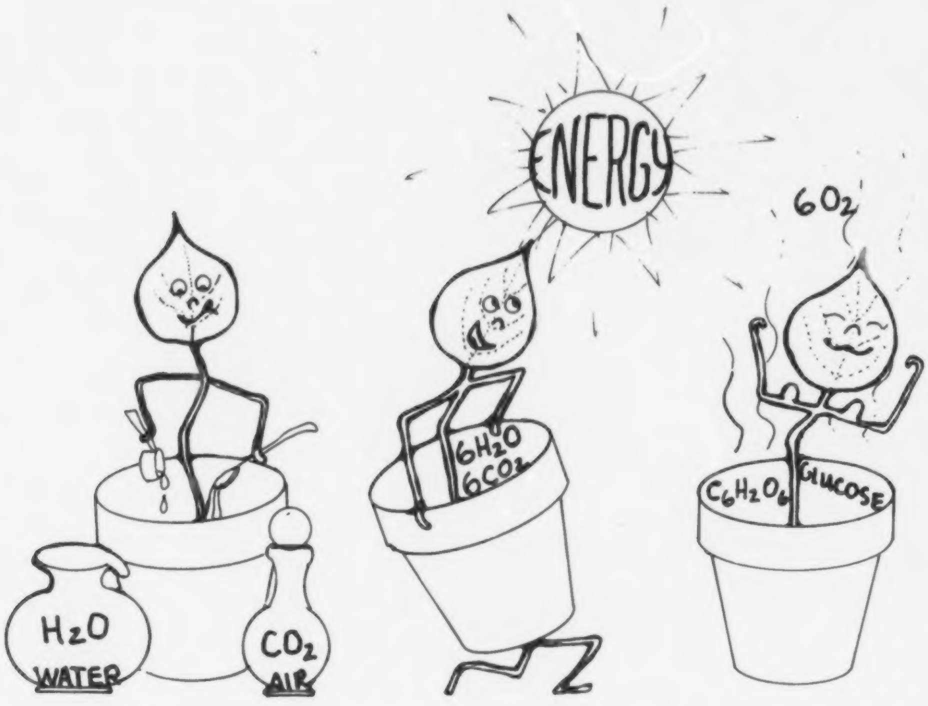
Reprinted with permission of *The Encyclopedia Americana*, 1980 edition, Grolier, Inc.

- Air passes in and out of the leaf through the stomata.
- Water and nutrients travel to the leaves through the sapwood (xylem) to be used in photosynthesis.
- Excess water is given off (transpired) into the atmosphere as water vapor, also through the stomata.

  NOTE: If the tree is giving off more water than it can take up from the roots, the stomata close and the tree stops making food and stops growing. It will stay dormant until more water is available or until it reaches the point from which it cannot recover, and will die.

- Respiration takes place 24 hours a day in every living cell. It uses the food manufactured by the leaves.

- In respiration, each cell, and the tree as a whole, takes in oxygen and gives off carbon dioxide.


H₂O
WATER
CO₂
AIR
ENERGY
6H₂O
6CO₂
6O₂
C₆H₂O₆
GLUCOSE

Mix Water and Air

Add Energy From the Sun

Results in Glucose

Photosynthesis (manufacturer of food)

$$6CO_2 + 12H_2O \xrightarrow[\text{chlorophyll}]{\text{light}} C_6H_{12}O_6 + 6O_2 + 6H_2O$$

Respiration (reverse process)

$$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O + \text{energy}$$

- During photosynthesis, the leaves make food for the tree by taking carbon dioxide (CO_2) from the air during respiration and mixing it with water and nutrients from the soil in the presence of chlorophyll and sunlight.

- The food produced by photosynthesis is sugar in the form of glucose.

- Oxygen is released into the atmosphere as a by-product of photosynthesis.

  NOTE: The tree releases more oxygen during photosynthesis than CO_2 as a result of respiration.

- Food is either stored for future use or moved downward to the growing parts of the tree through the phloem (inner bark) to the branches, trunk, and roots.

- Photosynthesis occurs only during the daytime.

  NOTE: Because the tree makes food during the day, the plant gives off mostly oxygen. At night, without the photosynthesis, it gives off mostly CO_2 through respiration.

- Using minerals from the soil, the tree changes the carbohydrates into fats and proteins.

- With the help of enzymes in the tree, fats change into starch, back to sugar, or to oils, latex, resin, vitamins, and other substances.

OBJECTIVE 5 **Match environmental and biological factors that affect tree growth to their descriptions.** (Assignment Sheet 1)

You know that your growth and development are influenced both by your environment and your genetic inheritance. Trees, too, will thrive in a favorable environment, growing as tall and strong as their genetic code will permit. Trees with the same good genes, however, will straggle along when food, sunlight, and water are limited. Seeds may not germinate when conditions are not favorable for growth and small trees may be stunted by overtopping large trees, by shallow soil or poor soil, or by harsh winds and extreme temperatures.

Environmental factors

- **Temperature**—Affects the speed of photosynthesis and respiration

  NOTE: Each individual tree has a range of temperatures in which it grows, in which photosynthesis and respiration occur at optimum rates, and in which it becomes dormant or suffers twig kill. The best temperature for loblolly pine seedling growth is 80° F during the day and 63° F at night.

- **Moisture**—The most limiting environmental factor, affecting all functions

  NOTE: The water-retaining properties of the soil are important in making moisture available to the tree.

- **Light**—Quality, intensity, and duration of light affect photosynthesis; photoperiod affects the growth of tree height and diameter

  NOTE: Periods of long daylight in spring and early summer produce the large-diameter, thin-walled springwood tree cells. Crown development is greater on the lighted side of the tree than on the shaded side.

- **Air**—Provides carbon dioxide required for photosynthesis and oxygen for respiration

- **Soil**—Holds moisture and provides the chemical elements needed for growth

  NOTE: How much moisture and nutrients are available to the tree is determined by soil texture, structure, depth, position, and chemical makeup. Some soils may not provide the nutrients to sustain good growth, and in some cases, fertilizers are applied to improve growth and health.

Biological factors

- **Reproduction**—Quality and amount of seeds or sprouts and their ability to withstand insect and weather damage
- **Tolerance**—The ability to withstand competition from other trees

  NOTE: See Objective 11 on crown classifications.
- **Root growth**—The ability to adapt and modify roots to the environment
- **Hardiness**—Ability to resist heat, cold, drought, insects, diseases, and other stress elements

OBJECTIVE 6 **State the methods of tree reproduction.**
(Supplements 2 and 3)

- **Sprouts**—Young plants grow from the base or from the stump

  NOTE: Broadleaf trees frequently sprout, but most conifers don't. The shortleaf pine and bald cypress are exceptions. A forest where trees are grown mainly from sprouting is called a "coppice" forest.
- **Suckers**—Underground roots send up shoots

  NOTE: Black locust can reproduce by suckering.
- **Seeds**—Formed from the sexual union of the female ovules and the male pollen

  NOTE: Southern pines reproduce by seeds (except for shortleaf pine which will also grow from sprouts). Hardwood trees reproduce either by seeds or by stump and root sprouts.

OBJECTIVE 7 **Select from a list characteristics of tree growth.**
(Assignment Sheet 2)

Trees grow in height and number of branches by adding a new growth of twigs. They grow in diameter by adding annual growth rings, a ring of cells that grows from the cambium layer by cell division.

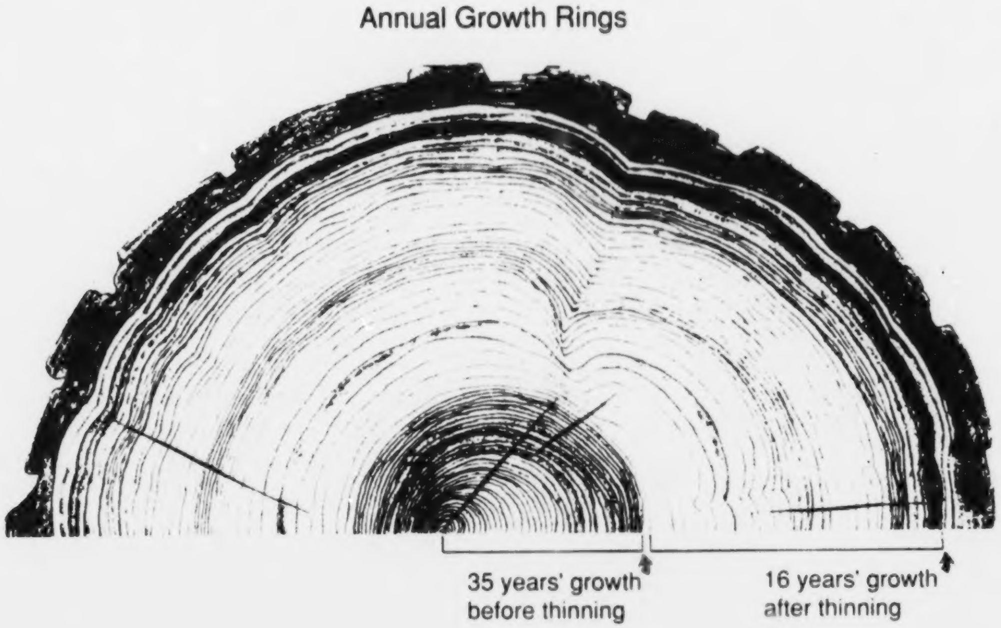
- The parts of the tree that grow are:
  - **Root tips**—Extend the root system for support or feeding
  - **Stem tips or buds**—Develop into branches, leaves, and flowers
  - **Cambium layer**—A single layer of cells lying between the bark and the wood in all parts of the tree. When the cells divide, they become new sapwood on the inside or new bark on the outside.
- **Types of wood**—As the cambium cells divide, they produce layers made up of many cells. When the tree is cut, we can count the rings to determine the tree's age, usually one light and one dark ring per year of growth. The two types of rings are:
  - **Summerwood**—The dark rings formed by small, dense, heavy-walled cells
  - **Springwood**—The lighter wood formed from large, thin-walled cells

  NOTE: False rings can be caused by differences in weather patterns. For example when a good-growing spring is followed by a dry period, the tree thinks it's time to slow up and grows thicker, denser cells. If another wet spell occurs in August, the tree will have a growth spurt and produce summerwood cells. You can tell the difference if you follow a ring all the way around the circumference. If it's a false ring, it will be much narrower than those around it and there won't be the same evenness of growth as in a true ring.
- **Annual growth rings**—Much can be learned from reading the annual rings. Fires, specific weather patterns, and thinning times can be determined in the width of the rings. Growth conditions which affect width of rings are:
  - **Rainfall**—Drought causes slower growth and narrower rings while plentiful rainfall produces increased growth and wider rings.

    NOTE: In a year of high rainfall, with optimum spacing and light exposure conditions, a tree may produce two rings.

- **Competition**—Where trees are crowded, growth rings are narrow as trees compete for space and light; the effects of thinning can be clearly seen as rings are wider from that time on.

NOTE: Conifers and some hardwoods need a lot of light while other hardwoods need less light. What kind of rings will you see if a tree has plenty of light and a long growing season?


Annual Growth Rings
35 years' growth before thinning
16 years' growth after thinning

Annual Growth Rings

This tree was released at the point where the rings grow wider because growth was faster.

Courtesy of Instructional Materials Service, Texas A&M University, College Station, Texas.

OBJECTIVE 8

Choose the best word or phrase to complete statements concerning stand classifications.

- **Age**
    - **Even-aged stands** contain trees all approximately the same age

      EXAMPLE: 30-year-old stand

      Trees with not more than 20 years difference are considered even-aged. In hardwood stands, 15-20 years difference is considered even-aged.
    - **Uneven-aged stands** contain three or more age classes.
    - **All-aged stands** contain trees of all ages.
- **Size**

  EXAMPLE: Pole timber stand
- **Composition**
    - **Pure stand**—at least 75% of the trees in the main crown canopy are of a single species.

      EXAMPLE: Shortleaf pine
    - **Mixed stand**—less than 75% of the trees in the main crown canopy are of a single species.

      EXAMPLE: Pine and hardwood

OBJECTIVE 9

Name tree sizes according to size classification. (Assignment Sheet 3)

NOTE: These classes are for Southern Forests. Size classifications for Northern Forests are different.

From smallest to largest:

- **Seedling**—Up to 3 feet tall
- **Sapling**—Taller than 3 feet but less than 4 inches DBH
- **Post**—4-6.9 inches DBH
- **Pole**—7-10 inches DBH
- **Sawlog**—10 inches DBH and up

OBJECTIVE 10

Match developmental stages in even-aged stands to their descriptions.

We talk about humans by size, as in 4-ft, 6-ft, "5-foot 2, eyes of blue," and we also describe humans by the developmental stages of our lives: infants, toddlers, pre-school, grade-school age, adolescents, adults, middle-aged, and elderly.

Trees in even-aged stands are classified by size as discussed in Objective 9 and also by developmental stages.

The developmental stages are:

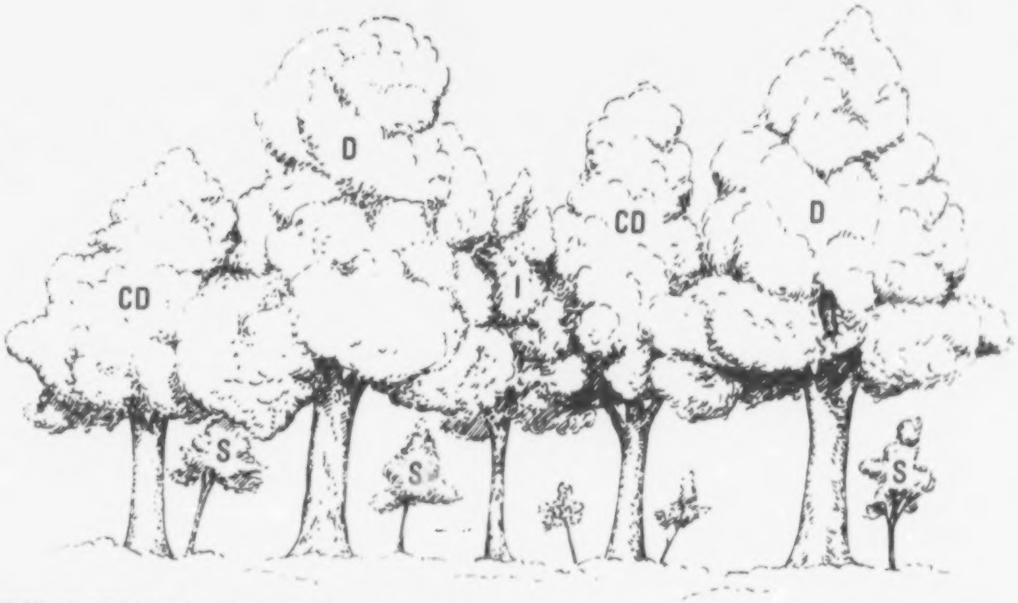
- **Seedling stage**—From seed until the stand begins to close
- **Sapling stage**—From the closing of the stand to the death of the lower limbs and with crowns well above the ground
- **Pole stage**—From the sapling stage through the stage where limbs are naturally pruned from the tree stem, leaving bare stems with crowns
- **Young timber stage**—From the attainment of full height to the decline of height growth
- **Mature timber stage**—From the completion of height growth to the start of the decline in quality and volume
- **Overmature timber stage**—From the start of quality and volume decline to deterioration

OBJECTIVE 11

Label trees according to crown classification.
(Assignment Sheet 4)

- **Dominant (D)**—Crown forms the upper level of the forest canopy; receives full sunlight on its crown and on the sides
- **Codominant (C)**—Medium-sized crown forming the general level of the canopy; receives full sunlight on the top of its crown and only partial light on the sides
- **Intermediate (I)**—Shorter crown, reaching just into the general canopy; receives partial sunlight on top of its crown
- **Suppressed (S)**—Small tree with crown below the general canopy; receives no direct sunlight

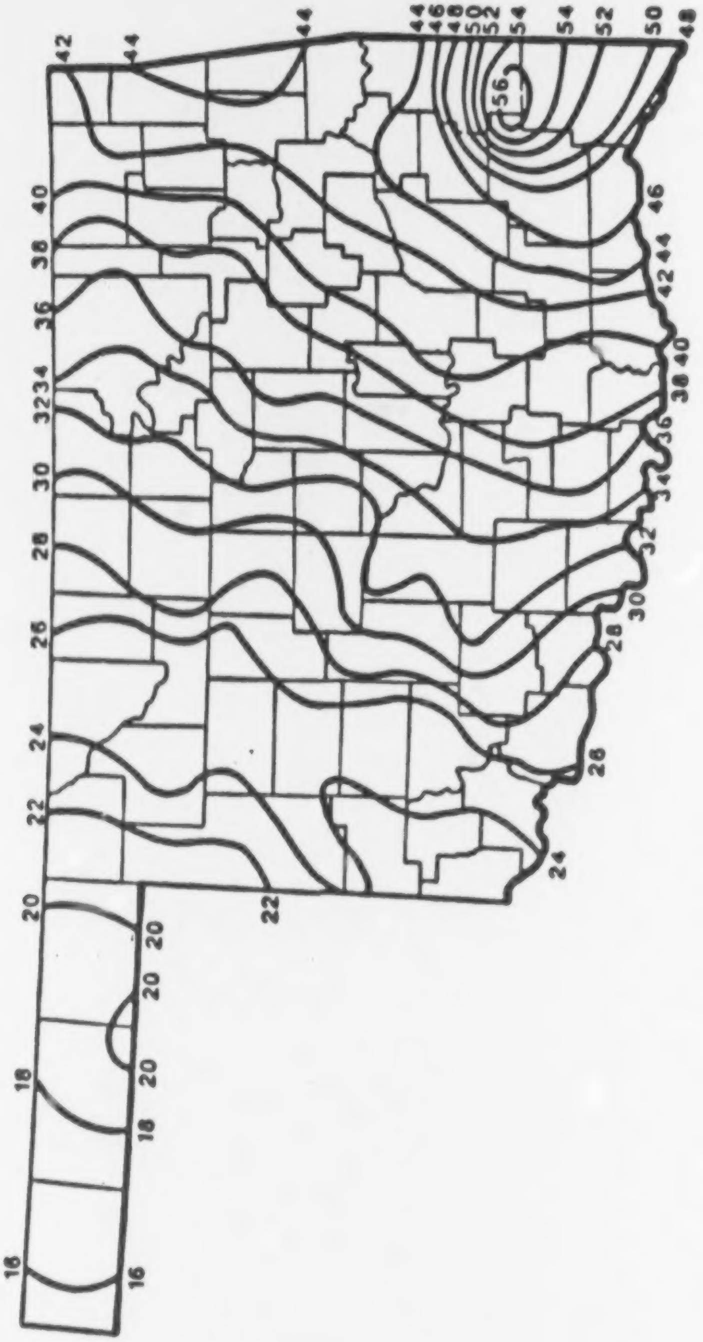
  NOTE: These small trees are called "suppressed" or "oppressed" when they are dying.



CROWN CLASSIFICATIONS D=Dominant; CD=Codominant; I=Intermediate; S=Suppressed.

Tree Classification by Tree Crown

OKLAHOMA RAINFALL CHART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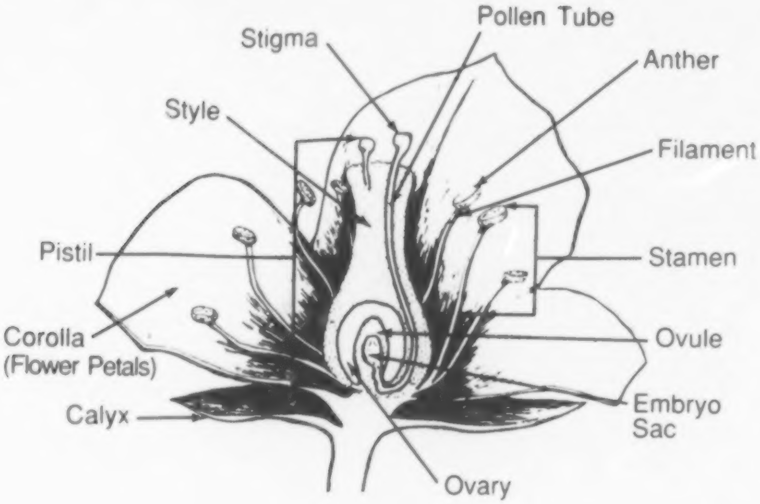
Courtesy of USDA



Parts of a Flower

Broadleaf trees—The stigma is the top of the female portion, or pistil. The pistil is sticky and receives pollen which has been dropped on it or carried to it by insects. The pollen may be produced by the male portion, or stamen, of the same flower; or pollen may be carried from another flower by wind or insects. The pollen travels down the style to the ovary, which contains one or more ovules.

Once the ovules are fertilized inside the ovary, they ripen to produce fruit such as acorns and pecans.

Conifers—The ovules are not encased in an ovary, but are borne naked on the cone scale. In the spring, the pine produces clusters of male, pollen-bearing cones or sacs and, at the same time, produces female cones. When the male's cones are ripe, they burst, dispersing the pollen. The female cone scales spread apart so the pollen can reach the stigma. Once in the female cone, the pollen grows a tube that reaches toward the ovule. This takes about a year. Once fertilized, the cone grows rapidly and develops seeds. The cone ripens and then dries. The scales come apart and the winged seeds travel on the wind or are carried by birds and animals to new locations.

ACTIVITY SHEET 1

DETERMINE PATTERNS OF TREE GROWTH AND CLASSIFICATION

IV

EXPLORE THE PARTS OF A TREE

DIRECTIONS

Depending on class size, divide into groups or let each person in the class be responsible for getting more information on the parts of a tree. Use the library to look up more detailed information. Gather actual samples of tree parts and share with the rest of the class. Build or draw a tree or tree parts, using construction paper, paper mache, chicken wire, crepe paper, or other materials, with individuals or groups creating the parts they studied.

Parts of trees:

Crown

- Leaves
- Twigs
- Flowers
- Fruit

Trunk

- Outer bark
- Inner bark (Phloem)
- Cambium
- Sapwood (Xylem)
- Heartwood
- Pith
- Pith rays

Roots

- Taproot
- Lateral roots
- Root tips or root hairs

ASSIGNMENT SHEET 1

DETERMINE PATTERNS OF TREE GROWTH AND CLASSIFICATION

IV

NAME ________________________________ SCORE _______

OBJECTIVE 12

Determine amount and distribution of average annual precipitation.

INTRODUCTION

Rainfall is vitally important to tree growth. It also has a direct effect on erosion, on the rate of decay of decomposing materials, on watershed and on wildlife habitat.

We can't predict when or how much rainfall will occur, but we have enough information on long-term rainfall totals to determine average amounts of precipitation as in Supplement 1. "Average annual precipitation" includes snow.

DIRECTIONS

Use Supplement 1 or a map of average annual precipitation for your state to answer questions about rainfall.

1. What is the annual average precipitation in your county? ______ inches
2. Which area of the state has the least precipitation?

   ____

3. Which area has the most precipitation?

   ____

4. Which area of your state is most heavily forested?

   EXAMPLE: North-central portion, southwest portion, eastern half, etc.

   ____

5. What is the range (lowest to highest amounts) of precipitation in that area? _______ inches

6. Tree growth drops at 50 inches per year. Refer to Unit III or a map showing forested regions to answer the following questions.

   a. How is this fact reflected in the distribution of forested areas in your state?

   ____

   ____

   b. What is the precipitation level where forestation drops off?
   _______ inches

7. 1 inch of rain = 17.4 million gallons per square mile
   = 27,200 gallons per acre
   = 100 tons per acre

   a. How much water falls on a 40-acre tract if the rainfall is .5 inch?
   _______ gallons

   b. How many gallons of water fall on one square mile of your town in an average year?
   _______ gallons

   c. What is the weight of rainwater on a 160-acre tract with an overnight precipitation reading of .7 inch?
   _______ gallons

8. Determine the amount and weight of rainfall in your county. Your teacher will provide the number of square miles.

   Average annual precipitation _______ inches

   a. There are 640 acres in a square mile.

   How many acres in your county?_______

   b. How many gallons fall in the county annually?
   _______ gallons

   c. How much does it weigh?
   _______ tons

ASSIGNMENT SHEET 2

DETERMINE PATTERNS OF TREE GROWTH AND CLASSIFICATION

NAME ______________________________ SCORE ________

OBJECTIVE 13 **Count annual rings to obtain information about trees.**

INTRODUCTION

The only way to really know about a tree's age and growth rate is to look at the annual rings. There is more than just age to be read in the rings. Climate and growing conditions can affect trees so that a 15-year-old tree may be the same size as a 5-year-old tree standing beside it. You can get a sense of history from trees, especially from large, older trees.

In Oklahoma the dust-bowl days were in the 1930s, affecting primarily the western part of the state. In 1951 a more serious, statewide drought lasted from 1951 to 1956, with the driest year in 1956. The next year, 1957, is the wettest year on record.

DIRECTIONS

Your teacher will provide at least three, and no more than six, cross sections of various species and various ages, cut at DBH.

NOTE: Southern yellow pine or oak is good; cedar is too hard.

Count either the dark or light rings. Remember that the light-colored springwood and the darker summerwood make one annual ring. Start with the first ring inside the cambium layer and count inward to the pith.

Look for variations in the width of the rings that could indicate drought periods, thinning, etc. and look for black fire scars.

Year that cross sections were cut:

Tree #1 ______________________________

Tree #2 ______________________________

Tree #3 ______________________________

NOTE: For the purposes of this assignment sheet only, use these guidelines to estimate how long it took the tree to grow to 4 1/2 feet:

If there are wide rings growing close to the pith indicating good growth, add three years.

If the rings close to the pith are narrow, add four years.

1. Count the rings to determine the age of the trees.

   Tree #1________

   Tree #2________

   Tree #3________

2. a. Identify years of good growth and slow growth. Remember to add three to four years for DBH growth.

Tree #	Good growth	Slow growth

   b. List any additional characteristics of interest in the trees.

   Tree #1________________________________

   Tree #2 ________________________________

   Tree #3 ________________________________

3. How big were the trees in 1980 when Ronald Reagan was elected President? Measure the diameter between the ring that was formed in 1980.

   If a tree is too young to have been alive at that time, write "NA" (for "not applicable") in the blank.

   Tree #1 ________

   Tree #2 ________

   Tree #3 ________

4. How big was the tree when your state entered the union?

   Year __________

   Tree #1 ________

   Tree #2 ________

   Tree #3 ________

5. Using the oldest cross section, determine the diameter of the tree at the time of each of the events listed below. Write "NA" in the blank if the tree did not exist at that time.

   a. __________The signing of the Declaration of Independence, July 4, 1776

   b. __________Lincoln's Gettysburg Address, 1863

   c. __________The Wright Brothers' flight at Kitty Hawk in 1903

   d. __________First transcontinental telephone talk, New York to San Francisco, Alexander G. Bell and Thomas A. Watson, 1915

   e. __________Dropping of the atom bomb on Japan, 1945

   f. __________Russian launch of Sputnik, the first earth-orbiting satellite, 1957

   g. __________Apollo-Saturn mission, landing of the first Americans on the moon, 1969

   h. __________Challenger spacecraft explosion after takeoff, 1986

   i. __________Destruction of the Berlin Wall between East and West Germany, 1990

   j. __________Your birthdate

6. In 1989 Oklahoma had a drought in spring and a very wet summer, followed by an unusual drought in the fall. Describe how the rainfall in 1989 is shown in the annual rings.

   ____

   ____

   ____

   ____

   ____

   ____

   ____

   ____

7. If you have the history of the stand and/or the weather for your region, your instructor may add additional questions to be answered below.

ASSIGNMENT SHEET 3

DETERMINE PATTERNS OF TREE GROWTH AND CLASSIFICATION

IV

NAME ________________________________ SCORE _______

OBJECTIVE 14

Identify trees using size classifications.

INTRODUCTION

An experienced forester can look at a tree and come very close to estimating the DBH. The first step in learning how to observe and estimate tree size is to learn the basic classification system. Test yourself with this assignment sheet and see how accurate you are at identifying trees by their sizes.

DIRECTIONS

Draw on the board or on paper lines of the following lengths:

4 inches

12 inches

24 inches

Study the length to get an approximate idea of tree classification sizes.

Measure 4 1/2 feet on your body to determine breast height.

Classify trees indicated by your instructor:

- Seedling—Up to 3 feet tall
- Sapling—Taller than 3 feet but less than 4 inches DBH
- Post—4-6.9 inches DBH
- Pole—7-10 inches DBH
- Sawlog—10 inches DBH and up

Write an "X" in the blank indicating the proper identification.

Tree No.	Seedling	Sapling	Post	Pole	Sawlog
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					
13.					
14.					
15.					

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ASSIGNMENT SHEET 4

DETERMINE PATTERNS OF TREE GROWTH AND CLASSIFICATION

IV

NAME ______________________________ SCORE _______

OBJECTIVE 15

Identify trees using crown classifications.

INTRODUCTION

As you learn about trees and forestry, you will learn to look at trees in a variety of ways—species, size, age, timber value, health and growth. As you learn to recognize the crown classifications of trees in a stand, you'll find yourself looking at the canopy as you never had before.

DIRECTIONS

Review Objective 11 and identify trees indicated by your instructor as:

Dominant (D)	Crown forms the upper level of the forest canopy; receives full sunlight on its crown and on the sides.
Codominant (C)	Medium-sized crown forming the general level of the canopy; receives full sunlight on the top of its crown and only partial light on the sides.
Intermediate (I)	Shorter crown, reaching just into the general canopy; receives partial sunlight on top of its crown.
Suppressed (S)	Small tree with crown below the general canopy; receives no direct sunlight.

Tree No.	Dominant	Codominant	Intermediate	Suppressed
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				

ASSIGNMENT SHEET 1

1. Correct answer according to map. ____ inches
2. Correct answer according to map.

   In Oklahoma, the panhandle.
3. Correct answer according to map.

   In Oklahoma, southeast corner.
4. Correct answer according to the state.

   In Oklahoma, the southeast corner and the east-central portion.
5. Correct answer according to map. ____ inches

   In Oklahoma, 44-54 inches.
6. a. Areas of 50 inches per year and more are obviously more intensely forested.

   b. Correct answer according to map. ____ inches

   In Oklahoma, about 30 inches per year
7. a. 544,000 gal

   b. Correct answer depends on average annual precipitation for your town.________ gal

   c. 11,200 gal
8. Average annual precipitation ____ inches

   a. There are 640 acres in a square mile.

      How many acres in your county? _______

   b. How many gallons fall in the county annually? ____ gal

   c. How much does it weigh? ____ tons

ASSIGNMENT SHEET 2

Answers to Assignment Sheet 2 will vary according to the cross sections the instructors provide.

1. Count the rings to determine the age of the trees. Complete the chart with the correct answers. Remember to add 3-4 years for DBH growth.

   Tree #1 ______________________

   Tree #2 ______________________

   Tree #3 ______________________

2. a. Identify years of good growth and slow growth. Complete the chart with the correct answers. Remember to add 3-4 years for DBH growth.

Tree #	Good growth	Slow growth

   b. List any additional characteristics of interest in the trees.

   Tree #1 ______________________

   ____

   ____

   Tree #2 ______________________

   ____

   ____

   Tree #3 ______________________

   ____

   ____

3. How big were the trees in 1980 when Ronald Reagan was elected President? Measure the diameter within the ring that was formed in 1980.

   If a tree is too young to have been alive at that time, write "NA" (for "not applicable") in the blank.

   Tree #1 ________________________

   Tree #2 ________________________

   Tree #3 ________________________

4. How big was the tree when your state entered the union?

   Year __________

   Tree #1 ________________________

   Tree #2 ________________________

   Tree #3 ________________________

5. Using the oldest cross section, determine the diameter of the tree at the time of each of the events listed below. Write "NA" in the blank if the tree did not exist at that time.

   a. __________The signing of the Declaration of Independence, July 4, 1776

   b. __________Lincoln's Gettysburg Address, 1863

   c. __________The Wright Brothers' flight at Kitty Hawk in 1903

   d. __________First transcontinental telephone talk, New York to San Francisco, Alexander G. Bell and Thomas A. Watson, 1915

   e. __________Dropping of the atom bomb on Japan, 1945

   f. __________Russian launch of Sputnik, the first earth-orbiting satellite, 1957

   g. __________Apollo-Saturn mission, landing of the first Americans on the moon, 1969

   h. __________Challenger spacecraft explosion after takeoff, 1986

   i. __________Destruction of the Berlin Wall between East and West Germany, 1990

   j. __________Student's birthdate

6. The springwood should be darker than other springwood and the summerwood lighter because of the moisture, becoming darker again in the fall.

7. If you have the history of the stand and/or the weather for your region, add additional answers below.

ASSIGNMENT SHEET 3

Fill in the chart with the correct answers, according to the trees you have selected to be identified by size classification.

Tree No.	Seedling	Sapling	Post	Pole	Sawlog
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					
13.					
14.					
15.					

ASSIGNMENT SHEET 4 Fill in the chart with the correct answers, according to the trees you have selected to be identified by crown classification.

Tree No.	Dominant	Codominant	Intermediate	Suppressed
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				

WRITTEN TEST

DETERMINE PATTERNS OF TREE GROWTH AND CLASSIFICATION

IV

NAME ______________________________ SCORE ________

OBJECTIVE 1

Match terms associated with patterns of tree growth and classification to their correct definitions. Write the correct letters in the blanks.

____ 1. Inactive

____ 2. Evaporation of water through the leaves

____ 3. In the female reproductive system, the sac that holds the ovule

____ 4. The distance around the outside of a circle

____ 5. The duration of sunlight in a day

____ 6. Diameter of a tree at 4 1/2 feet from the ground

____ 7. The layer of wood formed in a season's growth

____ 8. Process of breathing

____ 9. Minerals that promote growth and development

____ 10. Connected with steps or stages of growth

____ 11. The part that develops into a seed

____ 12. Process of making food from water, nutrients, carbon dioxide, and sunlight

____ 13. Anything produced in the course of making another thing

____ 14. When the leaves of adjacent trees touch

a. Pollen
b. Photosynthesis
c. Ovary
d. Nutrients
e. Ovule
f. Photoperiod
g. Closing of the stand
h. Transpiration
i. Bypass
j. Fertilizer
k. Annual rings
l. Dormant
m. Respiration
n. DBH
o.. Developmental
p. Stamen
q. Circumference
r. Radius
s. By-product

OBJECTIVE 2 **List the main parts of a tree.**

____

____

____

____

____

____

OBJECTIVE 3 **Match parts of the tree to their functions or descriptions.** Write the correct letters in the blanks. Some items require more than one answer.

____ 1. Protects tree from insects, disease, excessive heat and cold and other injuries

____ 2. A ribbon-like strand of tissue formed by the cambium and extending out across the grain

____ 3. Largest root of the root system; provides the main support for the tree and anchors it in the ground

____ 4. Current year's growth of the stem; carry nutrients between leaves and branches

____ 5. Dark, soft, spongy center in the core of the heartwood

____ 6. Female reproductive parts of the tree

____ 7. Carries sugar made in the leaves down to the branches, trunk, and roots where it is converted to other growth substances

____ 8. Carries the sap (water plus nitrogen and mineral nutrients) from the roots to the leaves; stores food

____ 9. Dark-colored, inactive center portion that was once sapwood; gives strength to the tree to keep it upright

____ 10. A layer of cells between the bark and wood where growth occurs, forming annual rings of new wood inside and new bark outside

a. Leaves
b. Heartwood
c. Outer bark
d. Seedlings
e. Flowers
f. Sapwood
g. Branches
h. Root tips or root hairs
i. Pith
j. Pith rays
k. Cadmium
l. Bole
m. Cambium
n. Taproot
o. Xylem
p. Lateral roots
q. Inner bark
r. Twigs
s. Fruit
t. Cones

___ 11. The ripened ovary of the flower, containing the seeds

___ 12. Take up water containing nutrients

___ 13. Manufacture food for the tree through photosynthesis and transpiration

___ 14. Side roots of root system; help support and anchor the trunk; hold root hairs

u. Phloem

v. Heartwood

w. Vertical roots

x. Ovaries

OBJECTIVE 4

Select from a list true statements about tree respiration and photosynthesis. Write an "X" in the blank before each true statement.

___ 1. Food is manufactured in the trunk.

___ 2. Respiration occurs only in the daytime.

___ 3. Both chlorophyll and sunlight are needed for photosynthesis.

___ 4. Trees breathe through microscopic pores on the tops of their leaves.

___ 5. Air passes in and out of the leaf through the stomata.

___ 6. Excess water is given off (transpired) into the atmosphere as water vapor.

___ 7. Water and nutrients travel to the leaves through the sapwood (xylem) to be used in photosynthesis.

___ 8. In respiration, each cell and the tree as a whole takes in oxygen and gives off carbon dioxide.

___ 9. The chemical formula for photosynthesis is:

$$\text{Energy} + 6\ HC_1\ CO_2 + 6\ H_2O \longrightarrow C6\ HC_1\ O6 + 6\ O_2$$

___ 10. The food produced by photosynthesis is sugar in the form of glucose.

___ 11. CO_2 is released into the atmosphere as a by-product of photosynthesis.

___ 12. Photosynthesis occurs only during the daytime.

___ 13. Storage is the first step after food manufacture.

___ 14. The chemical formula for respiration is:

$$C_6\ H_{12}\ O_6 + 6O_2 \longrightarrow 6CO_2 + 6\ H_2O + \text{energy}$$

OBJECTIVE 5 **Match environmental and biological factors that affect tree growth to their descriptions.** Write the correct letters in the blanks.

____1. Provides carbon dioxide required for photosynthesis and oxygen for respiration

____2. The ability to withstand competition from other trees

____3. Affects the speed of photosynthesis and respiration

____4. Holds moisture and provides the chemical elements needed for growth

____5. Ability to resist heat, cold, drought, insects, diseases, and other stress elements

____6. Quality and amount of seeds or sprouts and their ability to withstand insect and weather damage

____7. Quality, intensity, and duration of light affect photosynthesis; photoperiod affects the growth of tree height and diameter

____8. The most limiting environmental factor, affecting all functions

____9. The ability to adapt and modify parts to the environment

a. Dormancy
b. Light
c. Hardiness
d. Tolerance
e. Reproduction
f. Respiration
g. Durability
h. Temperature
i. Fertility
j. Moisture
k. Root growth
l. Air
m. Soil

OBJECTIVE 6 **State the methods of tree reproduction.**

OBJECTIVE 7

Select from a list characteristics of tree growth. Write an "X" in the blank before each correct answer.

____ 1. The parts of the tree that grow are the root tips, the stem tips or buds and the cambium layer.

____ 2. The cambium is made up of many layers of cells.

____ 3. When the cambium cells divide, they become new sapwood on the inside or new bark on the outside.

____ 4. Years of drought create a series of wide rings.

____ 5. The annual rings reflect high, medium, and low temperatures.

____ 6. Annual growth rings are caused by growth in the stem tips, the root tips and the cambium cells.

____ 7. Springwood is formed by small, dense, heavy-walled cells and is lighter colored than summerwood.

____ 8. Summerwood has dark rings and is formed by small, dense, heavy-walled cells.

____ 9. Springwood is a lighter colored wood than summerwood and is formed from large, thin-walled cells.

____ 10. The width of rings varies according to rainfall and competition among trees.

____ 11. Competition affects sunlight, space, and the rate of movement in the xylem.

____ 12. Trees grow in height by adding a new growth of twigs.

OBJECTIVE 8

Choose the best word or phrase to complete statements concerning stand classifications. Draw a circle around the correct answers.

1. A stand containing trees with 10-20 years difference is classified as_____

   a. uneven-aged

   b. even-aged

   c. all-aged

2. A stand of 30-year-old trees is classified as ______ .

   a. uneven-aged

   b. even-aged

   c. all-aged

3. Pure and mixed stands are classified according to ______ .

   a. planted vs. natural

   b. species

   c. canopy

4. A stand without any management is MOST LIKELY to be classified as ______ .

   a. uneven-aged

   b. even-aged

   c. all-aged

5. The important percentage in classifying stands by composition is ______ .

   a. 65%

   b. 75%

   c. 85%

OBJECTIVE 9 **Name tree sizes according to size classification.**

1. 10 inches DBH and up ________________________________
2. 7-10 inches DBH ________________________________
3. 4-6.9 inches DBH________________________________
4. Up to 3 feet tall ________________________________
5. Taller than 3 feet but less than 4 inches DBH ____________
____

OBJECTIVE 10

Match developmental stages in even-aged stands to their descriptions. Write the correct letters in the blanks.

____ 1. From the completion of height growth to the start of the decline in quality and volume

____ 2. From the start of quality and volume decline to deterioration

____ 3. From the closing of the stand to the death of the lower limbs and with crowns well above the ground

____ 4. From seed until the stand begins to close

____ 5. From the attainment of full height to the decline of height growth

____ 6. From the sapling stage through the stage where limbs are naturally pruned from the tree stem, leaving bare stems with crowns

a. Sapling stage

b. Germinating stage

c. Pole stage

d. Deadwood stage

e. Young timber stage

f. Seedling stage

g. Overmature timber stage

h. Veteran stage

i. Sapling stage

j. Mature timber stage

OBJECTIVE 11

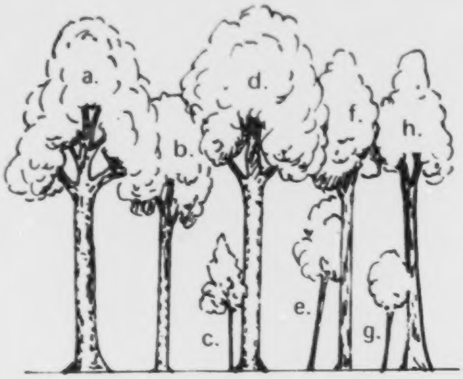
Label trees according to crown classification.

PART 1

Write classifications and the letter abbreviations that stands for them.

PART 2

Write the abbreviation of the crown classification for the trees below.



a. ____________

b. ____________

c. ____________

d. ____________

e. ____________

f. ____________

g. ____________

h. ____________

NOTICE The following assignment sheets are not part of the written test. If these activities have not been completed, check with your instructor.

OBJECTIVE 12 **Determine amount and distribution of average annual precipitation.** SCORE ________

OBJECTIVE 13 **Count annual rings to obtain information about trees.** SCORE ________

OBJECTIVE 14 **Identify trees using size classifications.** SCORE ________

OBJECTIVE 15 **Identify trees using crown classifications.** SCORE ________

WRITTEN TEST ANSWERS

DETERMINE PATTERNS OF TREE GROWTH AND CLASSIFICATION

IV

OBJECTIVE 1

1. l
2. h
3. c
4. q
5. f
6. n
7. k
8. m
9. d
10. o
11. e
12. b
13. s
14. g

OBJECTIVE 2

- Crown
- Trunk
- Roots

OBJECTIVE 3

1. c
2. j
3. n
4. r
5. i
6. e
7. q, u
8. f, o
9. b
10. m
11. s
12. h
13. a
14. p

OBJECTIVE 4

3, 5, 6, 7, 8, 10, 12, 14

OBJECTIVE 5

1. l
2. d
3. h
4. m
5. c
6. e
7. b
8. j
9. k

OBJECTIVE 6

- Sprouts—Young plants grow from the base or from the stump
- Suckers—Underground roots send up shoots
- Seeds—Formed from the sexual union of the female ovules and the male pollen

OBJECTIVE 7

1, 3, 8, 9, 10, 12

OBJECTIVE 8

1. b
2. b
3. b
4. c
5. b

OBJECTIVE 9

1. Sawlog
2. Pole
3. Post
4. Seedling
5. Sapling

OBJECTIVE 10

1. j
2. g
3. a
4. f
5. e
6. c

OBJECTIVE 11

PART 1

D - Dominant

C - Codominant

I - Intermediate

S - Suppressed

PART 2

a. D

b. I

c. S

d. D

e. S

f. C

g. S

g. C

OBJECTIVE 12 Refer to answers to Assignment Sheet 1.

OBJECTIVE 13 Refer to answers to Assignment Sheet 2.

OBJECTIVE 14 Refer to answers to Assignment Sheet 3.

OBJECTIVE 15 Refer to answers to Assignment Sheet 4.

OBJECTIVE SHEET

IDENTIFY FOREST TREES

V

INTRODUCTION

A forester can identify tree species just as a farmer can recognize crops or a rancher knows the breeds of cattle or sheep. Learning this part of forestry is hard work, but it is also fun. It is a skill that is essential in forestry and important to a wide range of agricultural and outdoor pursuits.

PREREQUISITES

None

UNIT OBJECTIVE

After completing this unit, the student should be able to identify basic taxonomy and characteristics of leaves, fruits, twigs, and important softwoods and hardwoods. The student will demonstrate these competencies by completing the assignment sheets and written test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with tree identification to their correct definitions.
2. Identify nomenclature and taxonomy terms.
3. Distinguish between characteristics of gymnosperms and angiosperms.
4. Name identifying characteristics of trees, given their descriptions.
5. Name parts of a leaf.
6. Draw common leaf arrangements.
7. Label common leaf shapes.
8. Label leaf margins.
9. Label parts of a twig.
10. Identify trees.
11. Compile a leaf and twig collection. (Assignment Sheet 1)
12. Identify trees using a key. (Assignment Sheet 2)

PREPARATION

- Obtain materials to supplement unit.

  NOTE: See Suggested Resources.

- Review instructional outline for this unit. Modify time frames to suit class needs and plan activities for each class period.

- Study the specific objectives to determine those you will cover in your presentation. Decide also which objectives should be taught to which students.

- Determine scope and sequence of objectives that you add. Design and develop support materials, including evaluation techniques, for additional objectives.

- Determine how you will schedule time for students to demonstrate competence in the required procedures.

  NOTE: Allow sufficient time for students to compile their leaf and twig collections.

- Invite a forester to speak to the class about the importance of learning techniques for tree identification.

  NOTE: Supply guest speakers with specific objectives and other appropriate sections of the unit.

- Plan a tree-ID field trip in a forest, local park, neighborhood, school yard, etc.

- Make transparencies from Transparency Masters.

DELIVERY

Objective 1

- For students interested in forestry competitions, stress that tree identification is a major part of the test.

- Let students try to define terms from their existing knowledge.

- Discuss terms and definitions.

- Bring in branches or show slides and let students identify those they can. Let them record the percentage they can identify for comparison with later identifications.

Objective 2

- Use Transparency Master 1 to discuss classification systems.
- Have students share the nomenclatures they know with the class.
- Go through the taxonomy for a tree, animal or plant well known to students.

Objective 3

- Discuss characteristics of gymnosperms and angiosperms.
- Let students handle and compare leaves, fruits, twigs and bark from gymnosperms and angiosperms for comparison.
- Identify common local trees of each type.

Objectives 4 through 8

- Have students bring leaves to class for practice identification.
- Discuss leaf characteristics, parts, shapes, margins, and arrangements.
- Use Transparency Master 3 to show tripinnately compound and bipinnately compound leaves and to reinforce leaf arrangements.
- Use Transparency Master 4 to demonstrate how to study a leaf.
- Find examples of each type in the collected samples.
- Have students begin Assignment Sheet 1.
- Let students mount leaves on index cards and have a leaf identification contest with teams or individuals.

Objective 9

- Use Transparency Master 4 to discuss the parts of a twig and compare softwood and hardwood twigs.

- Bring and have students bring twigs from both types of trees and let them handle and study them, recording the differences in their own words.

- Bring in "mystery twigs" and let students identify them as gymnosperm or angiosperm twigs.

Objective 10

- Provide students with a list of trees they will be responsible for identifying.

- Provide slides or photographs or require students to obtain keys for your region.

- Refer students to descriptions of hardwoods and softwoods in *Forest Trees of Oklahoma* or a similar key for your area. Add handout of descriptions of trees in your area, if desired.

- Use Transparency Master 3 to practice leaf identification using the key. The tree is a Harvard Oak, *Quercus havardii*, also called a shin oak, or shinnery.

APPLICATION

Objective 11

- Provide a tree identification key for student use if they don't already have a key.

- Use Assignment Sheet 1 to have students compile a leaf and twig collection.

- Give them sufficient time to gather samples and build the book.

- Stress neatness and an attractive presentation.

- Encourage them to collect samples to be identified in state and national competition.

Objective 12

- Provide a tree identification key for student use if they don't already have a key.

- Use Supplements 2 and 3 and Transparency Master 3 to give students practice in identifying the Harvard oak.

- Use Assignment Sheet 2 to give students practice and experience in using an identification key.

- Use the leaves from Objectives 4 through 8 and the twigs from Objective 9 to practice using a key.
- Mark three hardwood and three softwood trees for identification in a wooded area.

  NOTE: If a field trip is not possible, use pictures or slides.
- **Students should use the key to determine the species, not their current experience.** Select several less-common species.

EVALUATION

Written Test

- Explain to students that they will be asked to demonstrate on the written test actions listed in the specific objectives.
- Give written test.

  NOTE: The written test may be given in sections if desired.
- Evaluate students on assignment sheet activities if not previously done.
- Reteach and retest if necessary
- Complete appropriate section of competency profiles.
- Review individual and group performance in order to evaluate teaching methods. Adjust scope, sequence, or instrucional approaches for additional lessons as required.

SUGGESTED RESOURCES

Speakers

Oklahoma Natural Resources Speakers Bureau sponsored through Oklahoma State University, Division of Agriculture, Oklahoma Cooperative Extension Service - Forestry, Oklahoma Conservation Commission and the Oklahoma Forestry Association. Lists speakers on a variety of forestry-related topics. Speakers operate on a time-available basis. Request a listing of speakers, programs, slide presentations and videotapes from your local extension office or from:

Dr. Steve Anderson
Forestry Dept.
Oklahoma State University
239 Agricultural Hall
Stillwater, OK 74078
(405) 744-9431

Dave Marcouiller
Forestry Dept.
Oklahoma State University
242 Agricultural Hall
Stillwater, OK 74078
(405) 744-5444

Teachers from outside of Oklahoma should contact the Forestry Extension Office in their state.

Audiovisual Materials

- *Some Major Tree Species of the U.S.*, 117 slides, carousel with cassette. Outlines major tree species native to the United States. Available on a free-loan basis from the Forestry Extension Program at OSU, 242 Agricultural Hall, Stillwater, OK 74078, (405) 744-5444 or 744-9431.

Publications

- *Forest Trees of Oklahoma* or other key to tree indentification in your area.

  NOTE: This publication is available from the Curriculum and Instructional Materials Center, Oklahoma Department of Vocational and Technical Education, 1500 W. Seventh Avenue, Stillwater, OK 74074, phone (800) 522-5810 ext. 589. Out-of-state, (800) 654-4502.

UNIT REFERENCES

- Anderson, David A. and I. I. Holland, *Forests and Forestry*, The Interstate Printers & Publishers, Inc., Danville, Illinois, 1982.
- Brockman, Frank C., and Rebecca Merrilees, *Trees of North America: A Guide to Field Identification*, Golden Press, Western Publishing Company, New York, 1968.
- *Harvesting Forestry Products*, Texas A&M University, College Station, Texas, 1976.
- Hoadley, R. Bruce, *Understanding Wood: A Craftsman's Guide to Wood Technology*; The Taunton Press, Newtown, Conneticut, 1980.
- Stoddard, Charles H. and Glenn M. Stoddard, *Essentials of Forestry Practice*, 4th ed., John Wiley & Sons, New York, 1987.
- *Forest Trees of Oklahoma*, Oklahoma Forestry Division, State Department of Agriculture, Oklahoma City, Oklahoma, 1981.

INFORMATION SHEET

IDENTIFY FOREST TREES

V

OBJECTIVE 1

Match terms associated with tree identification to their correct definitions.

- **Bract**—A small leaf located either below a flower, on the staff of a flower cluster or on the scales of pine cones
- **Compound fruit**—Those that develop from several pistils joined together
- **Fruit**—A ripened ovary (sac that holds seeds) that may also contain some parts of the flower
- **Key**—An outline or shortcut for identifying a specimen by the process of elimination
- **Lenticels**—Lens-shaped body of cells on a stem; serve as pores
- **Lobe**—Roundish division of a leaf
- **Nomenclature**—System of names used in a branch of learning

  EXAMPLE: Common names and botanical names
- **Pendant cone**—Hanging downward from the twig, as opposed to sitting upright on the twig
- **Samara (SAM-uh-ruh)**—Dry, winged fruit, usually having a single seed
- **Simple fruit**—Those that develop from a single pistil

  EXAMPLES: Apple, acorn, Osage orange

  NOTE: Keys group species according to taxonomy and characteristics such as twigs, leaves, flowers, fruits, bark.
- **Sinus**—The separation between lobes
- **Taxonomy**—Science of classification

  NOTE: *Taxonomists* are scientists who identify and classify plants and animals.

OBJECTIVE 2

Identify nomenclature and taxonomy terms.
(Transparency Master 1)

Taxonomists use two systems for naming plants, common names and binomial or scientific names. An international set of rules, called *The International Code of Botanical Nomenclature*, has been drawn up to ensure that every different plant species has a different binomial name and that it is the oldest binomial name ever used for that plant. The scientific name is a universal language, used and understood by foresters, botanists, biologists, and other scientists all over the world.

- **Common name**—Popular, familiar, or local plant name

  Most plants have more than one common name; some have several. Common names are confusing. The same plant may be known by different common names in different parts of the country.

  EXAMPLE: The tree known as the redbud in the Southwestern United States is called a Judas tree in the Eastern United States

  In addition, two different plants may have the same common name.

  EXAMPLE: In New York State, the cowslip is a buttercup-like plant that grows in marshes. But in New England, the cowslip is a primrose-like plant that comes from dry, grassy slopes.

- **Binomial name**—The scientific plant name, which consists of two Latin names

  EXAMPLES: *Pinus echinata* - Shortleaf pine
  Quercus alba - White oak
  Quercus rubra - Red oak

- The first name is known as the **generic** name; this is the plant's group name. All plants having the same generic name belong to the same **genus** (GEE-nus)

  EXAMPLES: *Pinus* is Latin for pine
  Quercus is Latin for oak
  Juniperus is Latin for juniper
  Ulmus is Latin for elm

- Related genera (JEN-uh-ruh, plural of genus) are grouped together into *families*

  EXAMPLES: All pine trees belong to the same family; all oaks are in the same family; all elms. The Rose family includes trees with a stone or seeded fruit surrounded with flesh: apples, plums, cherries, peaches, pears, apricots, almonds, strawberries, raspberries, and blackberries; also ornamental shrubs: roses, spireas, hawthorns, firethorns, and mountain-ashes.

- The second name is the **specific** name. All plants having the same specific name belong to the same **species**.

  NOTE: Plants of the same species have the same characteristics and will consistently produce plants of the same type. Sometimes the species name will be a Latin term for a location, for the discoverer or namer, for color, or for some other characteristic of the species.

  EXAMPLES: *Ulmus americana* - American elm
  Juniperus virginiana - Eastern juniper; "virginiana" refers to the eastern U.S.
  Quercus alba - White oak; "alba" means white and comes from the same word as "albino"
  Quercus rubra - Red oak; "rubra" means red and comes from the same word as "ruby"
  Pinus echinata - Shortleaf pine; "echinata" means "bristly" or "prickly"
  Pinus taeda - Loblolly pine; "taeda" means "torch" and comes from the fact that pine pitch was used for lighting in ancient times

- Today, some species are subdivided into **varieties** or **cultivars**, that may resemble another variety, but they always have one or two consistent, inherited differences.

  EXAMPLE: *Prunus persica* var. *nectaria* is a nectarine tree, and a variety of the peach tree, *Prunus persica*.
  Quercus virginia fusiformis is a Texas live oak, which is a fusiform variety of the eastern oak. Fusiform means "spindle-shaped." The tree is an oak, but has rounded, spindle-shaped leaves instead of the characteristic oak leaves.

Procedures for scientific naming

- Because scientific names are written in Latin, a foreign language, they are written in *italics*. When they are written by hand or on a typewriter, scientific names are underlined.

Other rules that govern scientific names:

- **Genus**
  - Always written first
  - Begins with a capital letter
  - Usually a noun
- **Species**
  - Always written last
  - Begins with a lowercase letter
  - Usually an adjective

OBJECTIVE 3

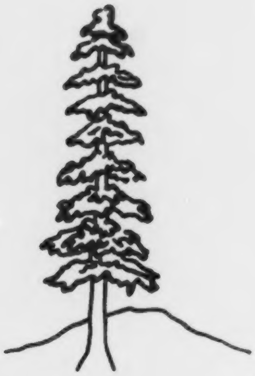
Distinguish between characteristics of gymnosperms and angiosperms.

Trees are divided into two classes, gymnosperms (JIM-no-sperms) and angiosperms (AN-gee-oh-sperms). These terms are from Greek words. *Sperm* means seed. *Gymno* means naked, bare, or uncovered; and *angio* comes from a word meaning vessel or container.

Gymnosperm—A plant bearing naked seeds.

EXAMPLES: Pines, junipers, cedars, firs

- Generally evergreen
- Called conifers or softwoods
- Wood has no pores, but resin ducts
- Leaves are needlelike, scalelike, or awl-like
- Fruit is a woody or fleshy cone
- Characteristic shape: Excurrent, meaning a dominant main stem with lateral side branching

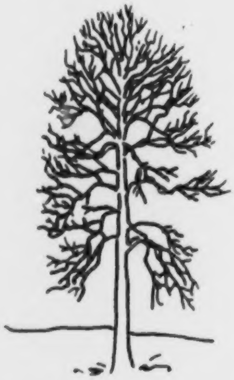


Gymnosperm

Angiosperm—Plant bearing closed seeds.

EXAMPLES: Oaks, elms, pecans, maples, locusts

- Generally deciduous
- Called broadleaf trees or hardwoods
- Wood has pores and no resin ducts
- Leaves are broadened; expanded blades
- Fruit is dry or fleshy and encloses the seed
- Characteristic shape: Dendritic, meaning branching and rebranching of the main stem



Angiosperm

OBJECTIVE 4

Name identifying characteristics of trees, given their descriptions.

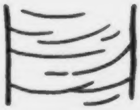
Tree identification begins with the class gymnosperm or angiosperm and then considers the following characteristics that differentiate one tree from another. Learning to recognize leaves, bark, twigs, fruit and branching habits means that foresters can identify any part of a tree in any season. This is especially important for angiosperms that lose their leaves in winter.

- **Leaves**—Most trees can be identified by the size, shape, color, texture, arrangement, type of apex, types of veins, and margin of the leaf. (See Objectives 6-8)

  NOTE: Leaves are the most important identifying feature. Leaf buds, leaf scars and branching on twigs can indicate leaf arrangement.

- **Bark**—Varies in thickness, roughness, types of crevices and color.

  NOTE: The bark is the most important identifying feature of large trees during the winter. Some barks can be identified by their color and odor.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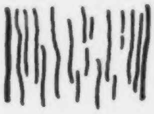
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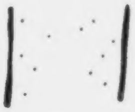
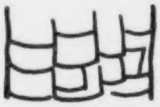

Smooth

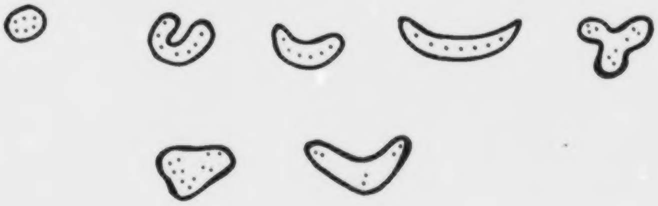

Scaly

- **Fruit**—May be simple or compound; simple fruits can be fleshy or dry; dry fruits are further divided into those that pop open when ripe and those that don't open. (Supplement 1)

EXAMPLES:

- **Simple**
  - Fleshy
    - Berries
    - Cherries
    - Apples
    - Pears
  - Dry
    - Those that pop open
      - Mimosa, redbud
      - catalpa
    - Those that don't open
      - Sycamore, maple
      - Nuts: oak, pecan, walnut
- **Compound**
  - Magnolia
  - Sweet gum

- **Twigs**—Buds, leaf scars, and bark are used for identification; color, smell, and shape of the pith can be useful. (See Objective 9)



Leaf Scar Shapes

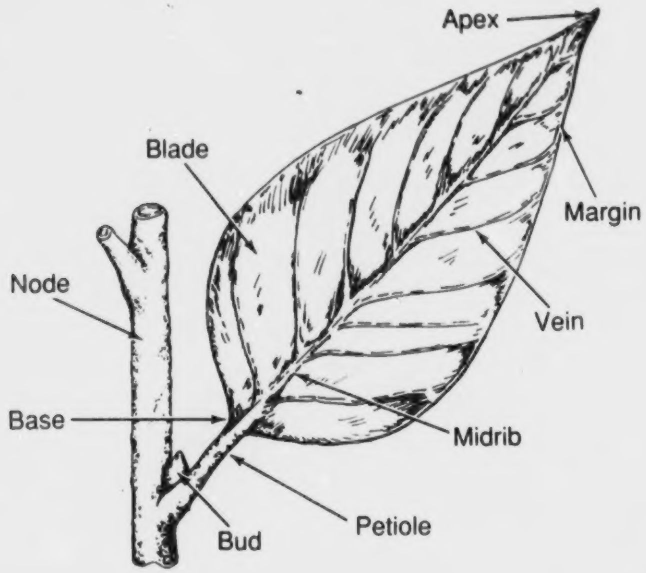
- **Tree form**—Tree size, shape, and branching habits are distinctive.

  NOTE: Tree form can be affected by its location and the location of surrounding trees. The amount of shade, water, nutrients, wind exposure, and crowding can keep the tree small or allow it to expand.

- **Wood**—Color and general structure of the wood are important clues, especially in closely-related species.

  NOTE: Some species of pine can only be identified by their cellular structure, examined under a microscope. The cellular structure provides an absolute identification of species.

OBJECTIVE 5 | **Name parts of a leaf.**


Apex
Blade
Margin
Node
Vein
Base
Midrib
Petiole
Bud

Leaf parts

- **Apex**—The tip or uppermost portion
- **Margin**—The outer edge
- **Base**—The bottom-most part
- **Veins**—Conduction system
- **Midrib**—Main vein extending from the twig through a petiole to the apex
- **Blade**—Expanded portion of a leaf
- **Petiole**—Stalk of a leaf
- **Bud**—New shoot or flower; also indicates the beginning point of a leaf

OBJECTIVE 6

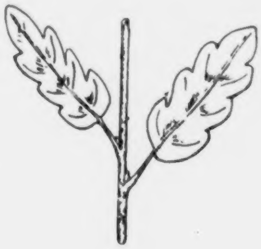
Draw common leaf arrangements.
(Transparency Masters 2 and 3)

Simple leaves

NOTE: Twigs have the same arrangement patterns as simple leaves.

- **Alternate arrangement**
  One leaf at a node

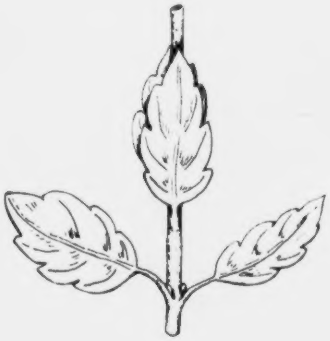
  EXAMPLE: Osage orange



Alternate

- **Opposite arrangement**
  Two leaves at a node

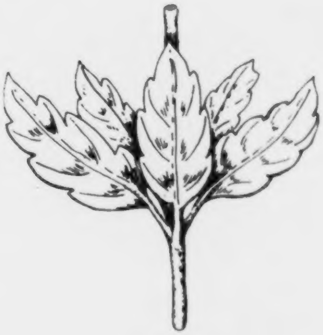
  EXAMPLE: Silver maple



Opposite

- **Whorled**
  More than two leaves at a node

  EXAMPLE: Magolia



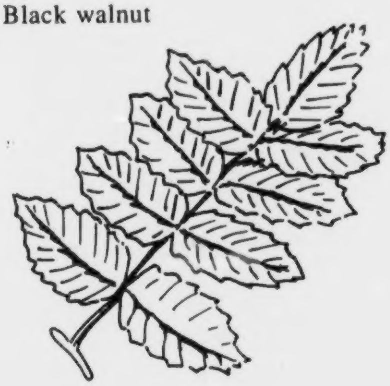
Whorled

Compound leaves

NOTE: These are the most common compound leaf arrangements. See Transparency 3 for additional classifications.

- **Pinnately compound**
  Leaflets are attached in two rows along an axis (like a feather), shedding together

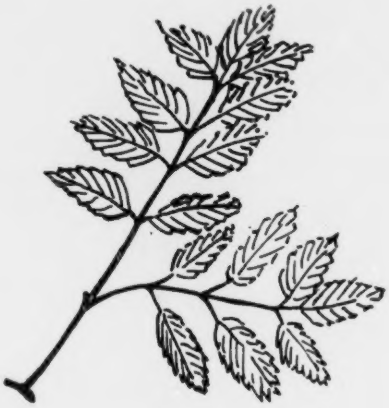
  EXAMPLE: Black walnut



Pinnately Compound

- **Bipinnately compound**
  The axis is branched or forked, with leaflets on branches (Bipinnate means "twice pinnate")

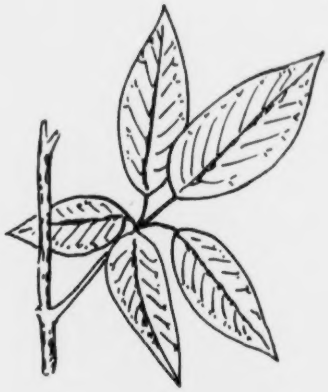
  EXAMPLE: Honey locust



Bipinnately Compound

- **Palmately compound**
  Leaflets are attached together at the end of the petiole (like fingers on the palm of the hand)

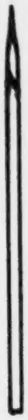
  EXAMPLE: Buckeye



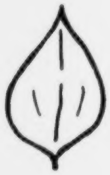
Palmately Compound

OBJECTIVE 7 **Label common leaf shapes.**

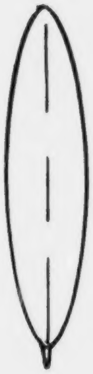
NOTE: The prefix *ob* means reverse. Cordate means "heart-shaped," and obcordate means the leaf is shaped like an upside-down heart.



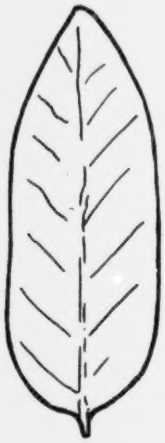
Acicular
Needlelike pine leaves
EX: Pine



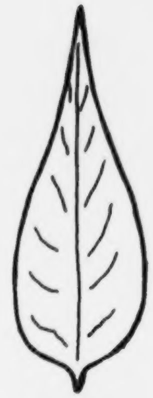
Scalelike or Awl-shaped
Small, short, sharp-pointed overlapped
or close together
EX: Eastern Redcedar



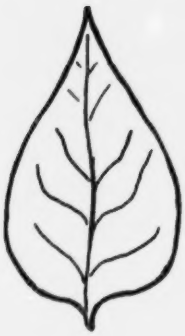
Linear
Long & narrow
EX: Willow Oak



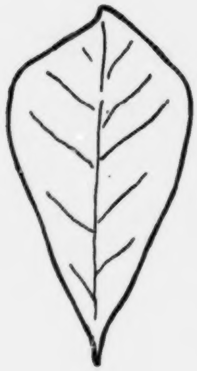
Oblong
Long & wide
EX: Persimmon



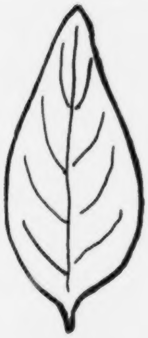
Lanceolate
Lance-shaped
EX: Black willow



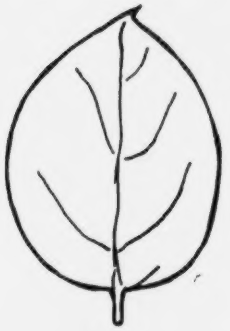
Ovate
Egg-shaped
EX: Osage orange



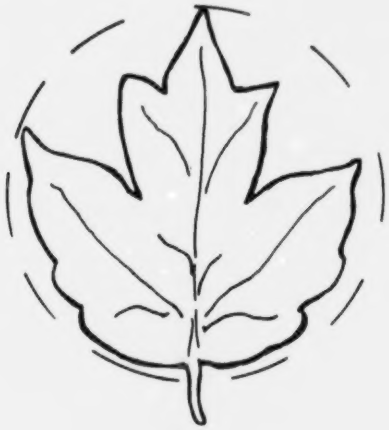
Obovate
Inverse
egg-shaped
EX: Black gum



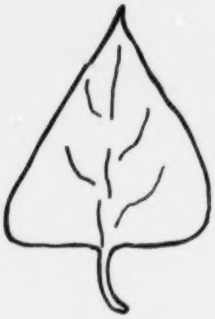
Elliptical
Shaped like
an ellipse
EX: American beech



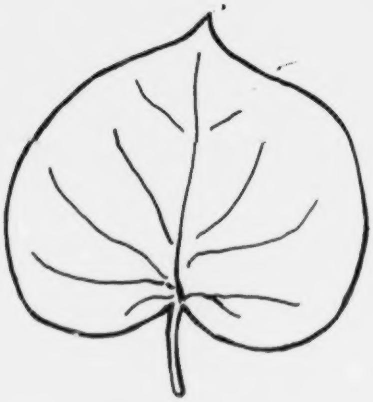
Oval
A broad
ellipse
EX: Dogwood



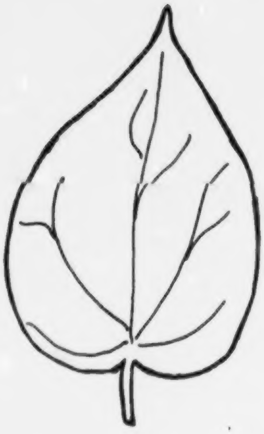
Orbicular
Circular
EX: Maple



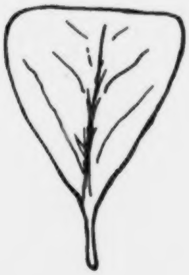
Deltoid
Triangular
EX: Cottonwood



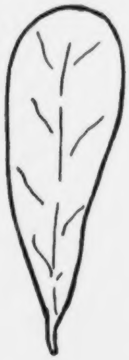
Reniform
Kidney-shaped
EX: Redbud



Cordate
Heart-shaped
EX: Catalpa

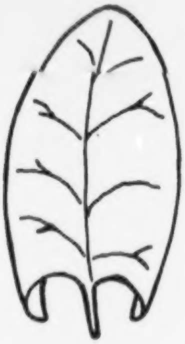


Obdeltoid
Inverse
triangular
EX: Gingko

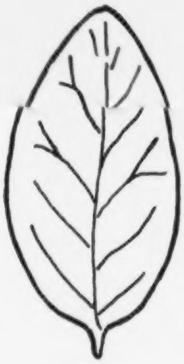


Spatulate
Wide at the
top and
narrowing
EX: Water oak

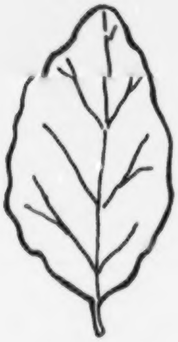
OBJECTIVE 8 | **Label leaf margins.** (Transparency Master 3)



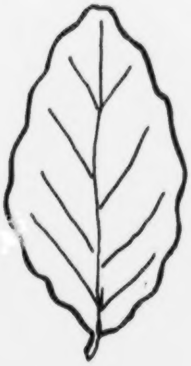
Revolute
Turned under
EX: Magnolia



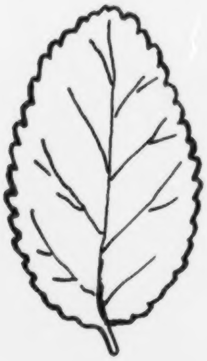
Entire
Smooth edge
EX: Western soapberry



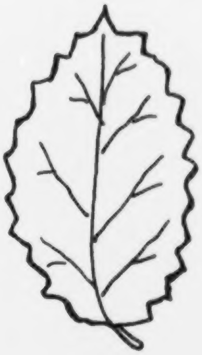
Repand
Wavy
EX: Laurel oak



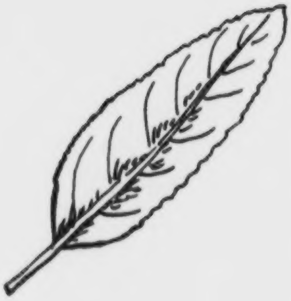
Sinuate
Very wavy
EX: Hercules club



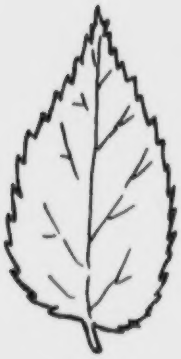
Crenate
Rounded teeth
EX: Eastern cottonwood



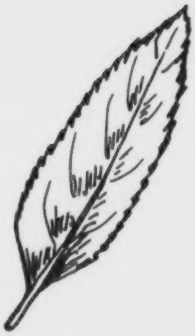
Dentate
Sharp teeth pointed out
EX: Chestnut



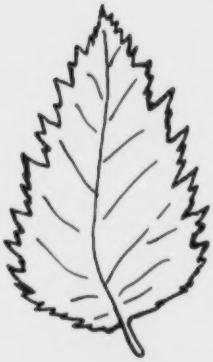
Crenulate
Finely round teeth
EX: Honeylocust



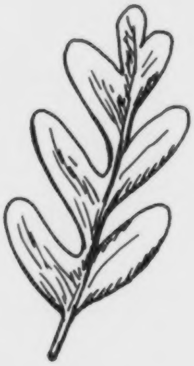
Serrate
Sharp teeth, pointed up
EX: American basswood



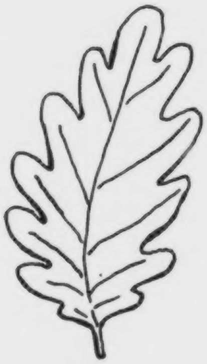
Serrulate
Finely serrated
EX: Black cherry



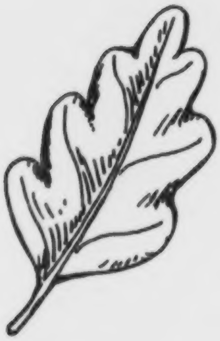
Doubly Serrate
Coarse and fine
EX: Birch



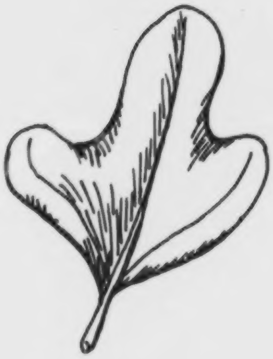
Divided
Sinus extends to
midrib
EX: Bur oak



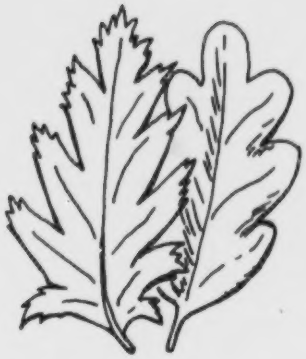
Lobed
Rounded sinus
EX: Scarlet oak



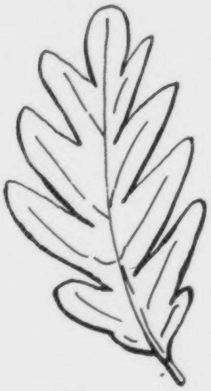
Pinnately Lobed
Lobing from midrib
EX: Southern red oak



Palmately Lobed
Lobing from base of leaf
EX: Sweetgum

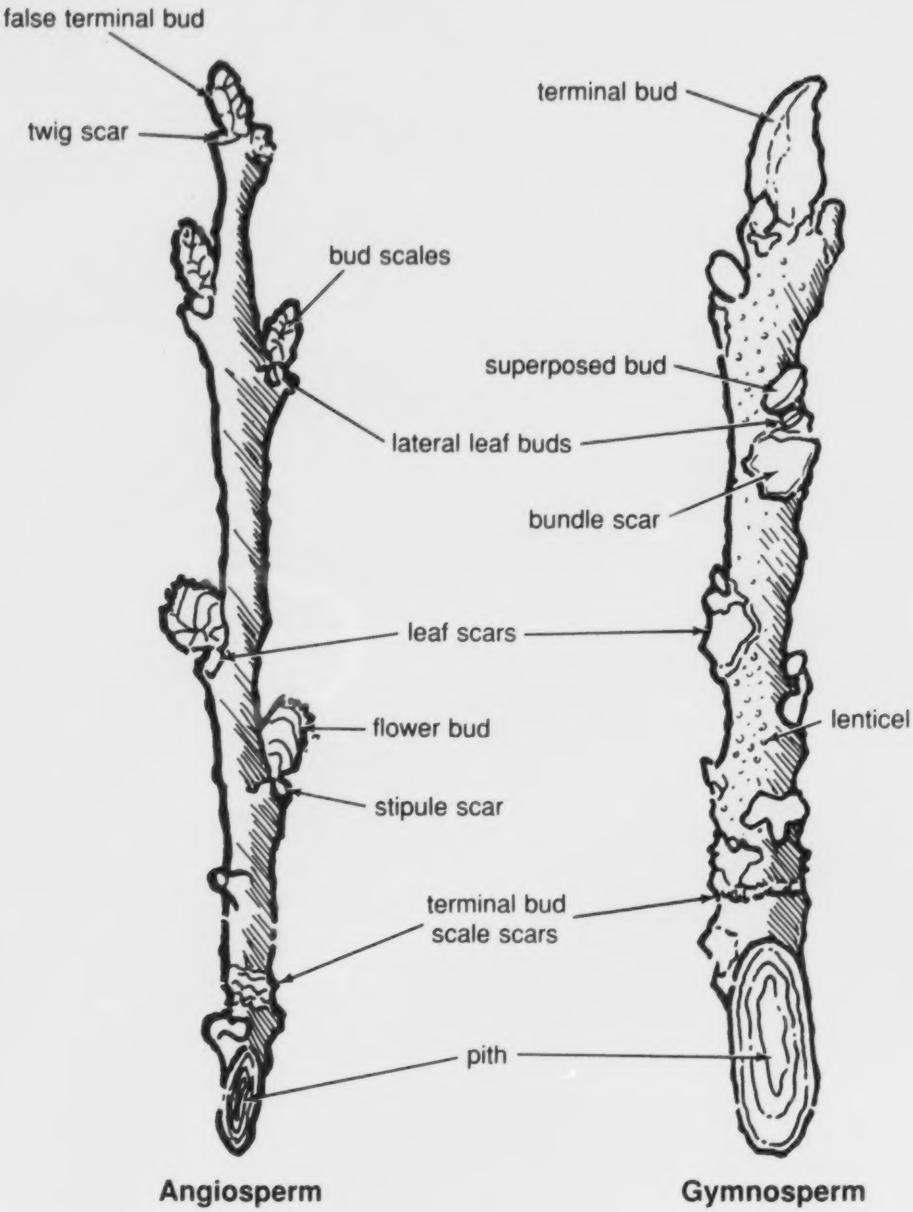


Cleft
Narrow, sharp sinuses
EX: Silver maple



Parted
Cleft extends to midrib
EX: Pin oak

OBJECTIVE 9 | **Label parts of a twig.** (Transparency Master 4, Assignment Sheet 1)

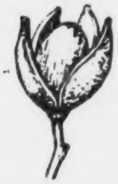

false terminal bud
twig scar
bud scales
lateral leaf buds
leaf scars
flower bud
stipule scar
terminal bud scale scars
pith
terminal bud
superposed bud
bundle scar
lenticel
Angiosperm
Gymnosperm

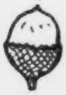
OBJECTIVE 10

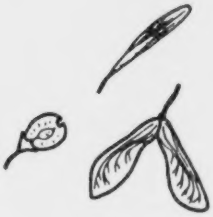
Identify trees. (Transparency Master 3, Assignment Sheets 2, 3, and 4)

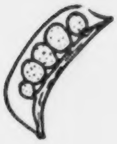
Study slides, keys, and additional information provided by your instructor to identify trees or slides of trees.

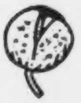
COMMON FRUITS

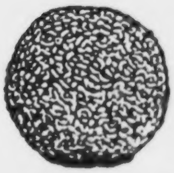

Nut
(Hickory)

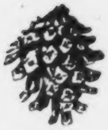

Acorn
(Oak)

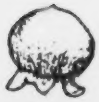

Keys (Samaras)

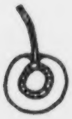

Pod
(Kentucky
Coffeetree)

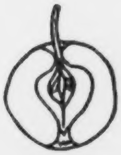

Capsule
(Buckeye)


Multiple
(Osage-orange)


Cone
(Pine)


Berry
(Persimmon)


Stone Fruit
(Drupe)
(Cherry)


Pome
(Apple)

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KEY TO OAKS

Part 4. Key to Oaks *(Quercus)*

Winter buds 3 or more in cluster at tip of twig from cluster of leaves; pith of twigs star-shaped in cross-section; fruit an acorn with cup of many tiny scales – OAK, *Quercus*.

A. Leaves and their lobes, if present, bristle-tipped; acorns maturing in second year; bark mostly blackish, rough and furrowed – BLACK OAKS or RED OAKS.

B. Leaves narrow, less than 2 in (5 cm) wide, with edges straight or slightly 3-lobed.

C. Leaves very narrowly oblong or lance-shaped, with straight edges, not lobed.

D. Leaves green and slightly shiny above, beneath light green and nearly hairless — 54. willow oak, *Quercus phellos*.

DD. Leaves shiny blue green above, beneath dull gray green and finely hairy — 44. bluejack oak, *Quercus incana*.

CC. Leaves oblong, with 3 short lobes, sometimes several, broadest near 3-lobed tip — 51. water oak, *Quercus nigra*.

BB. Leaves broad, more than 2 in (5 cm) wide, edges distinctly lobed and with bristle-teeth.

E. Under surface of leaves green and nearly hairless.

F. Leaves shallowly 7 – 11-lobed less than halfway to midvein; buds short-pointed, dark red, nearly hairless — 55. northern red oak, *Quercus rubra*.

FF. Leaves deeply 5 – 9-lobed nearly to midvein; buds long-pointed, gray or brown, hairless.

G. Leaf notches rounded nearly in circle, with lobes nearly touching — 56. Shumard oak, *Quercus shumardii*.

GG. Leaf notches broad and U-shaped, with lobes spreading.

H. Leaves 3-5 in (7.5-13 cm) long, shiny green above; ne. Okla — 53. pin oak, *Quercus palustris*.

HH. Leaves 4-8 in (10-20 cm) long, dark green above; Coastal Plain of se. Okla. — 52. Nuttall oak, *Quercus nuttallii*.

EE. Under surface of leaves with brownish or gray hairy coat.

I. Leaves slightly 3-angled, broadest near 3-lobed apex — 47. blackjack oak, *Quercus marilandica*.

II. Leaves mostly elliptical, 3 – 11-lobed.

J. Leaves deeply 7-9-lobed, shiny yellow green above, usually brown hairy beneath — 58. black oak, *Quercus velutina*.

JJ. Leaves deeply 3-11-lobed or slightly 3-lobed, shiny dark green above, densely gray or rusty hairy beneath — 41. southern red oak, *Quercus falcata*.

AA. Leaves and their lobes not bristle-tipped; acorns maturing in first year; bark mostly light gray, often scaly – WHITE OAKS.

K. Leaves small, less than 3½ in (9 cm) long, edges straight, slightly toothed, wavy, or lobed.

L. Leaves thick and stiff.

M. Leaves with edges usually straight and rolled under, evergreen; small tree; Wichita Mts. along Altus Reservoir — 59. Texas live oak, *Quercus virginiana* var. *fusiformis*.

MM. Leaves with edges various, not rolled under, deciduous (shedding in autumn); low thicket-forming shrub of shinnery or sometimes small tree – SHIN OAKS.

N. Leaves with edges slightly toothed, wavy, or lobed, densely white hairy beneath; acorns large, ½-1 in (13-25 mm) long, with broad cup; sw. and nw. Okla. except panhandle — 43. Havard oak, *Quercus havardii*.

NN. Leaves with edges straight or wavy, densely gray hairy with prominent veins beneath; acorns smaller, ⅜-⅝ in (10-15 mm) long; nw. Cimarron Co. — 49. Mohr oak, *Quercus mohriana*.

LL. Leaves thin, reverse ovate to elliptical, often slightly 3-lobed toward rounded tip or wavy lobed, beneath gray and hairy; Arbuckle Mts. and vicinity — 40. short-lobe oak, *Quercus durandii* var. *breviloba*.

KK. Leaves larger, more than 3½ in (9 cm) long, edges wavy or lobed.

O. Leaf edges deeply lobed.

P. Leaves elliptical, with 5-11 uniform lobes rounded at tip.

Q. Leaves hairless throughout, whitish green beneath; e. Okla. — 39. white oak, *Quercus alba*.

QQ. Leaves soft hairy beneath; nw. Cimarron Co. — 42. Gambel oak, *Quercus gambelii*.

PP. Leaves reverse ovate, broadest beyond middle, with lobes unequal or irregular, hairy beneath.

R. Leaves with 2 broad lobes suggesting a cross (3-lobed in a variety), slightly rough above — 57. post oak, *Quercus stellata*.

RR. Leaves deeply divided into several lobes.

S. Leaves with few short lobes toward base, upper half broad with shallow rounded lobes — 46. bur oak, *Quercus macrocarpa*.

SS. Leaves with 7-11 narrow lobes, se. Okla. — 45. overcup oak, *Quercus lyrata*.

OO. Leaf edges wavy with many uniform rounded teeth – CHESTNUT OAKS.

T. Leaves elliptical, beneath whitish green and covered with tiny hairs — 50. chinkapin oak, *Quercus muehlenbergii*.

TT. Leaves reverse ovate, broadest beyond middle, beneath gray green and densely covered with soft hairs — 48. swamp chestnut oak, *Quercus michauxii*.

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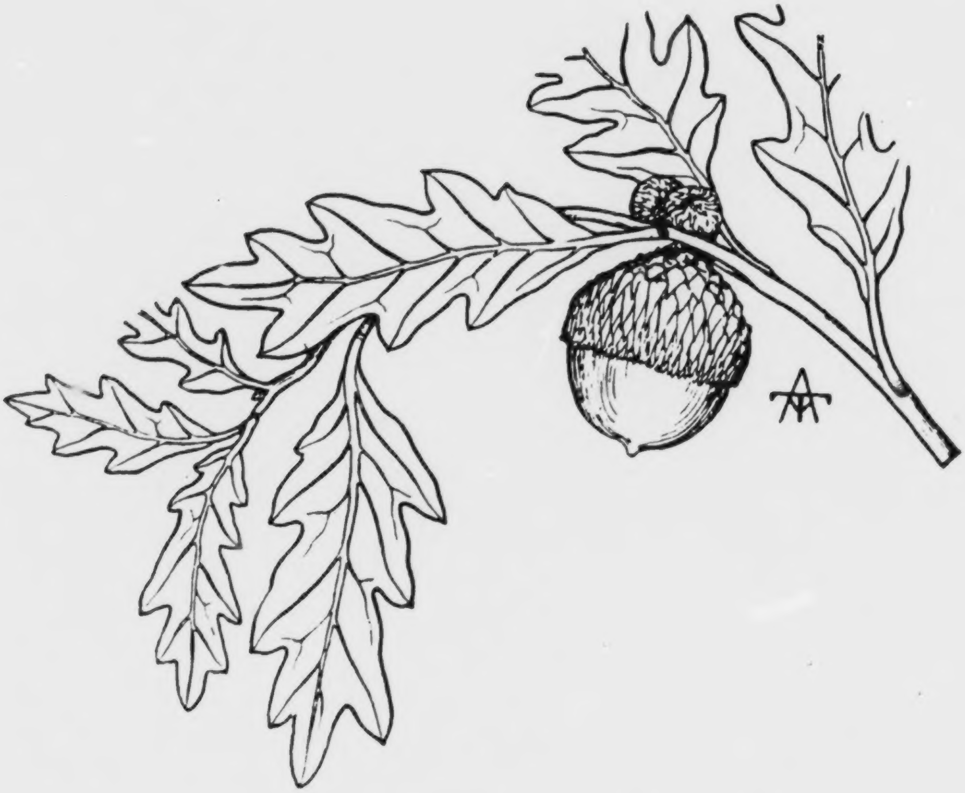
BEST COPY AVAILABLE



Usually a very *low shrub* 1-4 ft (0.3-1.2 m) high, growing in dense *thickets* from sprouts, forming *shinnery* but sometimes a small tree. **Twigs** slender, brown, often densely hairy, ending in cluster of small rounded dark red brown buds, slightly hairy.

Leaves oblong, elliptical, or ovate, sometimes lance-shaped, 3/4-3 in (2-7.5 cm) long, 3/8-1 1/2 in (1-4 cm) wide, rounded at tip, rounded to blunt at base, *edges slightly toothed*, wavy, or lobed, thick and stiff, shiny green and hairless above, beneath densely whitish hair with veins visible in network.

Acorns 1-2 nearly stalkless, large, 1/2-1 in (13-25 mm) long and wide, elliptical, 1/3-1/2 enclosed by deep broad scaly cup, maturing first year.

Bark light gray, becoming rough and scaly.

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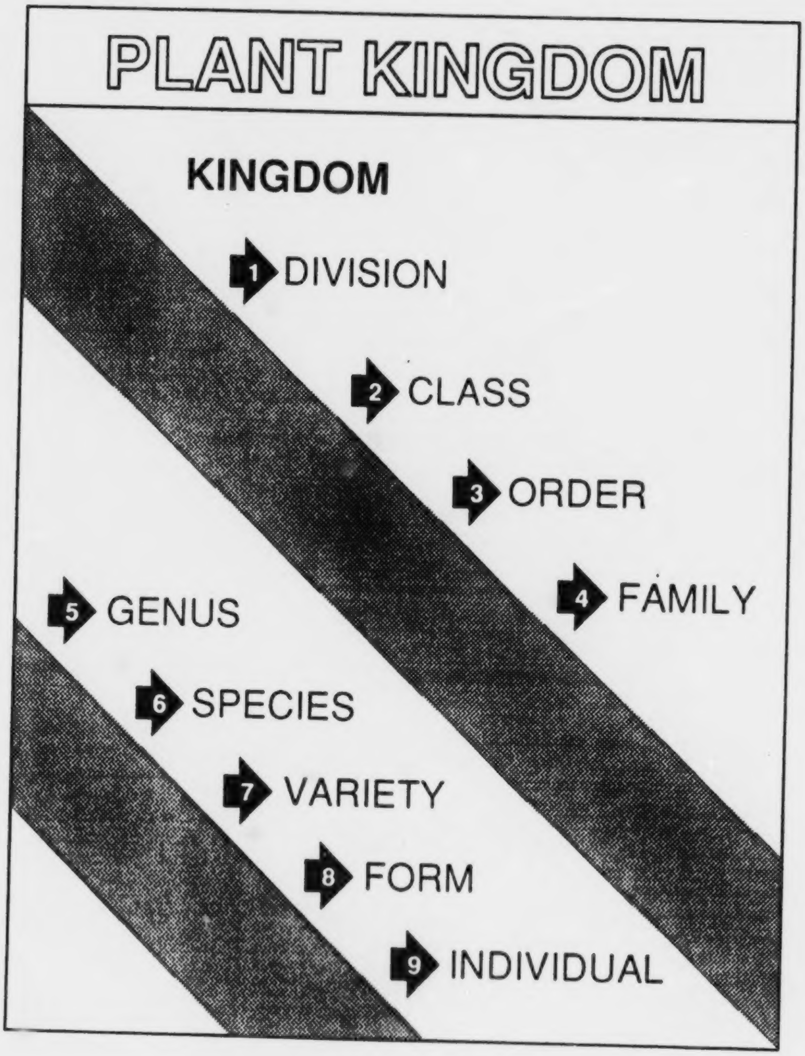
BASIC TAXONOMY

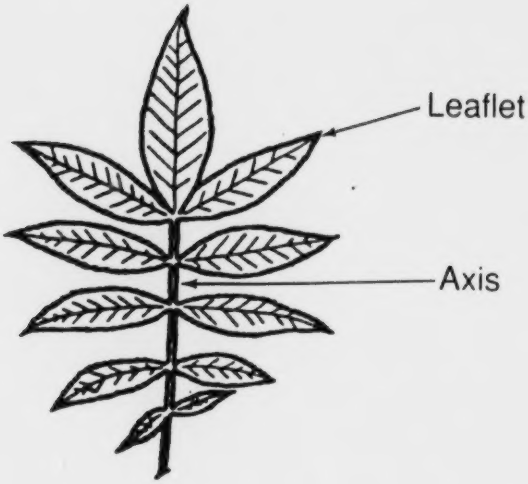


PLANT KINGDOM

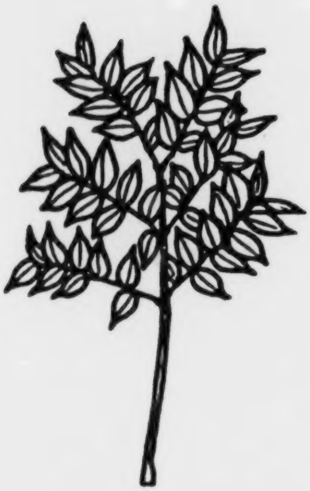
KINGDOM

1. DIVISION
2. CLASS
3. ORDER
4. FAMILY
5. GENUS
6. SPECIES
7. VARIETY
8. FORM
9. INDIVIDUAL

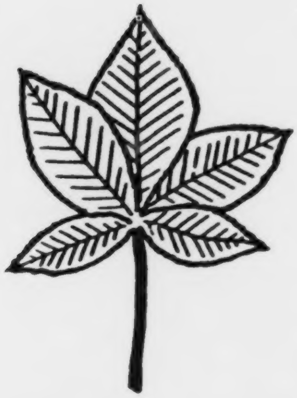
COMPOUND LEAVES



Pinnately Compound
(Hickory)



Bipinnately Compound
(Kentucky Coffeetree)



Palmately Compound
(Buckeye)

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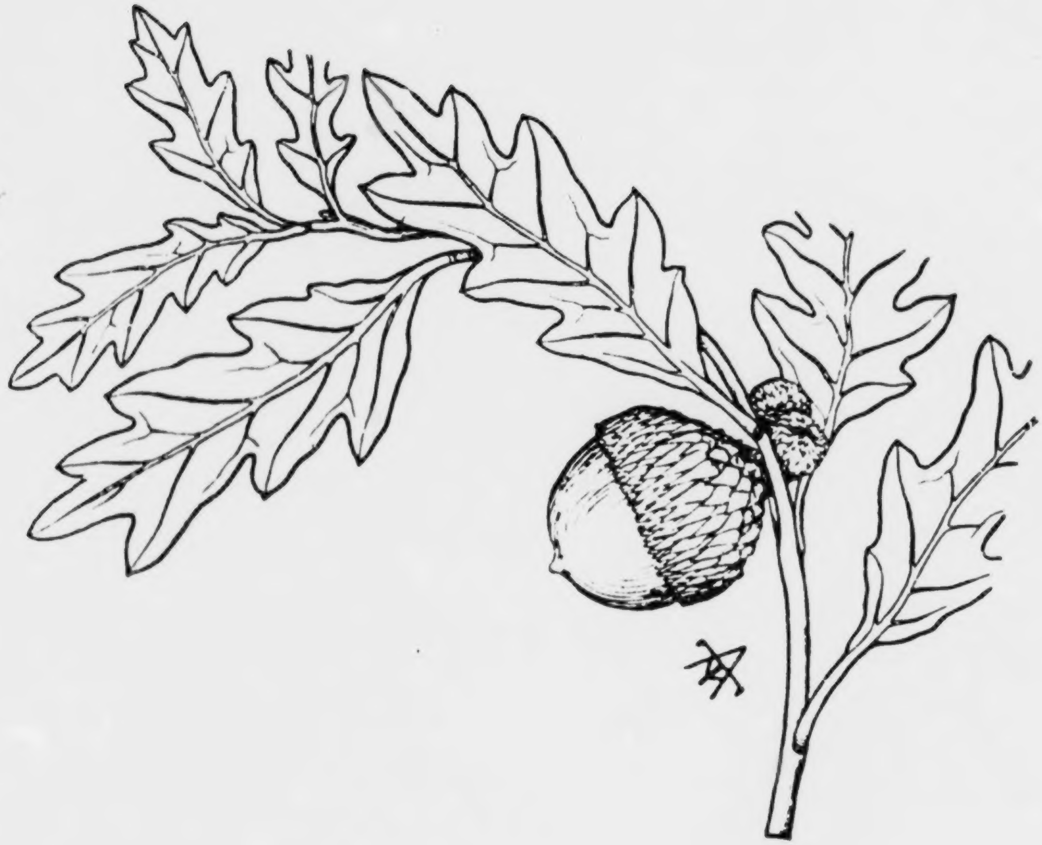
LEAF SECTION FOR IDENTIFICATION



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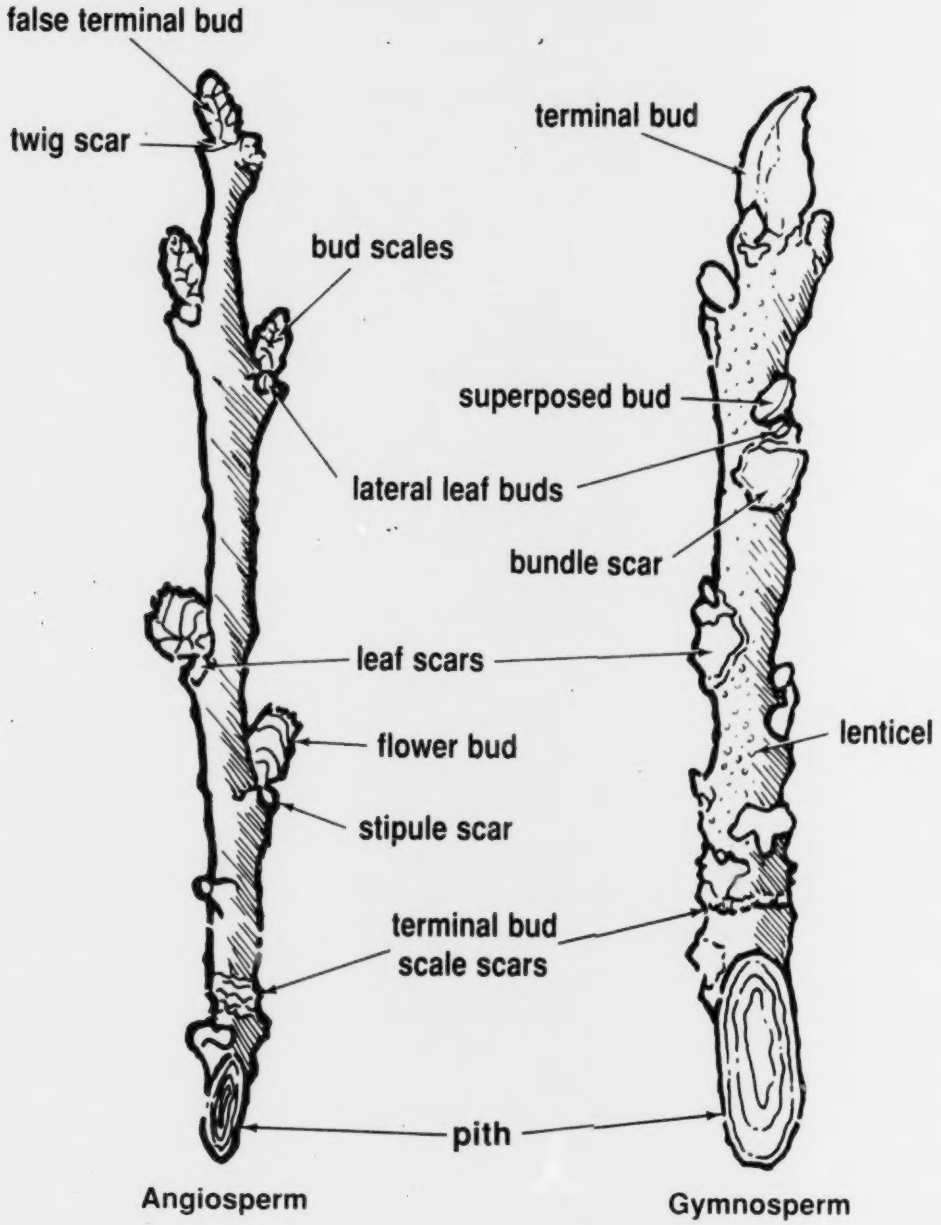
TWIG FEATURES


false terminal bud
twig scar
bud scales
lateral leaf buds
leaf scars
flower bud
stipule scar
terminal bud scale scars
pith
Angiosperm
terminal bud
superposed bud
bundle scar
lenticel
Gymnosperm

ASSIGNMENT SHEET 1

IDENTIFY FOREST TREES

NAME ______________________________ SCORE _______

OBJECTIVE 11

Compile a leaf and twig collection.

INTRODUCTION

A leaf and twig collection is your own record of trees in your area. Making the collection will help you learn the many characteristics and arrangements of leaves and twigs. The collection is easy, fun, and enables you to learn about and identify important forest trees in your part of the country.

Make a neat, clean collection that you can keep, use, and be proud of.

DIRECTIONS

1. Collect leaves and twigs from 25 different tree species.
2. Identify the trees using a key.
3. Dry the leaves between folds of newspapers with a board and weight on top for 3-5 days.
4. Tape or glue the dried leaves and twigs to heavy paper, such as pieces of brown paper bag, lightweight posterboard, construction paper, etc.

   NOTE: Glue or gummed cloth or plastic tape will hold better than cellophane tape. Other methods for mounting can be found in 4-H and Boy Scout Handbooks.

5. In the lower right-hand corner, write the common name and the scientific name.
6. Use a key or a taxonomy to arrange the pages in order by families.
7. Number the pages.
8. Make an attractive cover for the collection and put the pages together in book form.

ASSIGNMENT SHEET 2

IDENTIFY FOREST TREES

V

NAME ______________________________ SCORE _______

OBJECTIVE 12 **Identify trees using a key.**

INTRODUCTION

A key is an outline or shortcut for identifying a tree by the process of elimination. Keys group species using leaves and other characteristics. A key is a quick guide to determining a tree species. Keys are available for each region of the United States and for many states, for different characteristics and for different seasons.

Learning how to use a key is a valuable skill that can lead to increased knowledge and pleasure working in the forest.

How to use a key

NOTE: The instructions below are for using *Forest Trees of Oklahoma*. Many keys use a similar process. Follow instructions for the key you are using.

1. Select the class.

   EXAMPLE: Conifers or Deciduous - some keys will use gymnosperm/angiosperm or softwoods/hardwoods.

2. Select the type of leaf

   EXAMPLES: Gymnosperms: Needles, short or long; awl-shaped or acicular.

3. Select the leaf arrangement.

   EXAMPLE: Alternate simple leaves, alternate compound leaves, opposite leaves.

4. Follow the selection process in the key: type of leaf composition, twig characteristics, etc.

   EXAMPLE: Shape of leaves or leaflets, size, margin type.

   Letters identify a characteristic. The double letter at the same indentation identifies a different type of the same characteristic (this example is condensed from *Forest Trees of Oklahoma*):

ASSIGNMENT SHEET 1

Check for:

- Inclusion of the required number of trees
- Dried specimens
- Correct identification
- Common name and scientific name
- Arrangement by families
- Numbered pages
- Attractive cover
- Neatness

ASSIGNMENT SHEET 2

Students should identify the trees marked or the slides/photographs.

WRITTEN TEST

IDENTIFY FOREST TREES

V

NAME ______________________________ SCORE _______

OBJECTIVE 1

Match terms associated with tree identification to their correct definitions. Write the correct letters in the blanks.

___ 1. A ripened ovary (sac that holds seeds) that may also contain some parts of the flower

___ 2. Hanging downward from the twig, as opposed to sitting upright on the twig

___ 3. Roundish division of a leaf

___ 4. Those that develop from several pistils joined together

___ 5. The separation between lobes

___ 6. Science of classification

___ 7. A small leaf located either below a flower, on the staff of a flower cluster or on the scales of pine cones

___ 8. Those that develop from a single pistil

___ 9. Dry, winged fruit, usually having a single seed

___ 10. System of names used in a branch of learning

___ 11. An outline or shortcut for identifying a specimen by the process of elimination

___ 12. Lens-shaped body of cells on stem; serve as pores

a. Apex
b. Bract
c. Complex fruit
d. Compound fruit
e. Fruit
f. Indentation
g. Key
h. Leaflet
i. Lenticels
j. Lobe
k. Margin
l. Nomenclature
m. Outline
n. Pendant cone
o. Perimeter
p. Pith pores
q. Samara
r. Simple fruit
s. Sinus
t. Taxonomy

OBJECTIVE 2

Identify nomenclature and taxonomy terms.

1. Write "C" in the blank before a common name, "B" in the blank before a binomial name.

____ a. *Magnolia acuminata*

____ b. Cedar elm

____ c. *Pinus nigra*

____ d. *Ulmus crassifolia*

____ e. Austrian pine

_____f. Osage orange

2. In the examples below, underline the genus name with one line, the species name with two lines, and the variety name with three lines.

a. *Prunus americana* - American pine

b. *Aesculus glabra arguta* - Texas buckeye

3. The Latin word "saccharum" is an adjective meaning sugar and "acer" is a noun meaning maple.

a. Write the common name of the tree.

____

____

b. Write the binomial name.

____

____

c. Write the common family name of this tree.

____

____

OBJECTIVE 3

Distinguish between characteristics of gymnosperms and angiosperms. Write "G" in the blanks before gymnosperms and "A" in the blanks before angiosperms.

____ 1. Characteristic shape: Excurrent, meaning a dominant main stem with lateral side branching

____ 2. Leaves are needlelike, scalelike, or awl-like

____ 3. Leaves are broadened; expanded blades

____ 4. Wood has no pores, but resin ducts

____ 5. Generally deciduous

____ 6. Plant bearing enclosed seeds

____ 7. Wood has pores and no resin ducts

____ 8. Fruit is dry or fleshy and encloses the seed

____ 9. Generally evergreen

____ 10. Fruit is a woody or fleshy cone

____ 11. Called broadleaf trees or hardwoods

____ 12. Characteristic shape: Dendritic, meaning branching and rebranching of the main stem

____ 13. Called conifers or softwoods

____ 14. Plant bearing naked seeds

____ 15. Loblolly pine

____ 16. Red maple

____ 17. White oak

____ 18. Shortleaf pine

OBJECTIVE 4 **Name identifying characteristics of trees, given their descriptions.**

____________________ 1. Buds, leaf scars, and bark are used for identification; color, smell, and shape of the pith can be useful.

____________________ 2. Color and general structure are important clues, especially in closely-related species.

____________________ 3. May be simple or compound; simple forms can be fleshy or dry; dry forms are further divided into those that pop open when ripe and those that don't open.

____________________ 4. Most trees can be identified by the size, shape, color, texture, arrangement, type of apex, types of veins, and margin of this part.

____________________ 5. Size, shape, and branching habits are distinctive.

____________________ 6. Varies in thickness, roughness, types of crevices and color.

OBJECTIVE 5

Name parts of a leaf. Write the correct names in the blanks.

________________ 1. Expanded portion of a leaf

________________ 2. New shoot or flower; also indicates the beginning point of a leaf

________________ 3. Conduction system

________________ 4. Stalk of a leaf

________________ 5. Main vein extending from the twig through a petiole to the apex

________________ 6. The tip or uppermost portion

________________ 7. The outer edge

________________ 8. The bottom-most part

OBJECTIVE 6

Draw common leaf arrangements.

Simple leaves

1. Alternate arrangement

2. Opposite arrangement

3. Whorled

Compound leaves

4. Pinnately compound

5. Bipinnately compound

6. Palmately compound

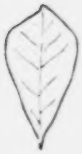
335

OBJECTIVE 7

Label common leaf shapes. Write the name of the leaf shape in the blank using the terms below.

Acicular
Scalelike
Linear
Oblong
Lanceolate
Ovate
Obovate
Spatulate

Elliptical
Oval
Orbicular
Reniform
Cordate
Obdeltoid
Deltoid



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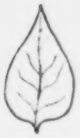

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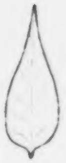

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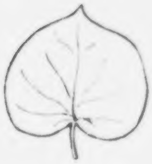

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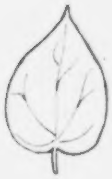

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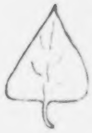

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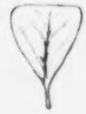

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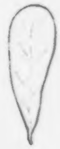
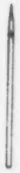


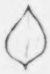
8. ________________



9. ________________

Acicular
Scalelike
Linear
Oblong
Lanceolate
Ovate
Obovate
Spatulate

Elliptical
Oval
Orbicular
Reniform
Cordate
Obdeltoid
Deltoid



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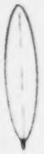
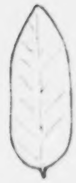


11. ____________________



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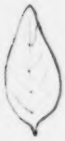

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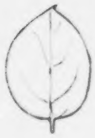

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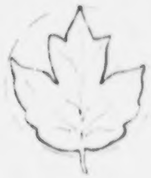


15. ____________________

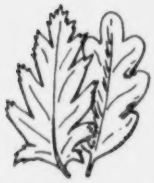
OBJECTIVE 8

Label leaf margins. Write the name of the leaf shape in the blank using the terms below.

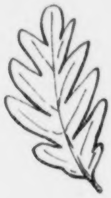
Revolute
Entire
Repand
Sinuate
Crenate
Crenulate

Lobed
Dentate
Serrate
Serrulate
Doubly serrate

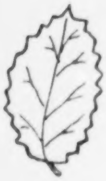
Divided
Pinnately lobed
Palmately lobed
Cleft
Parted



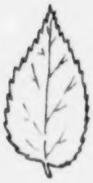
1.________________



2.________________



3.________________



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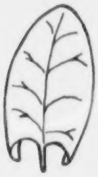

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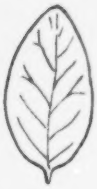
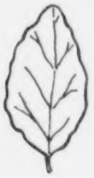


6.________________



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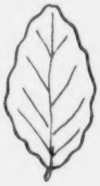
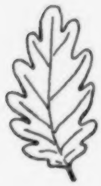


8.________________

Revolute
Entire
Repand
Sinuate
Crenate
Crenulate

Lobed
Dentate
Serrate
Serrulate
Doubly serrate
Divided

Pinnately lobed
Palmately lobed
Cleft
Parted



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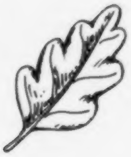

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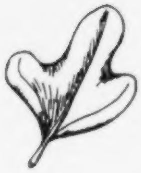

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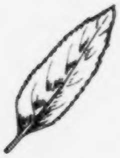

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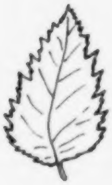

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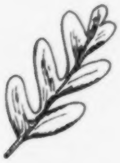

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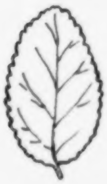
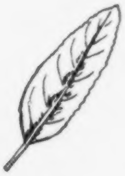


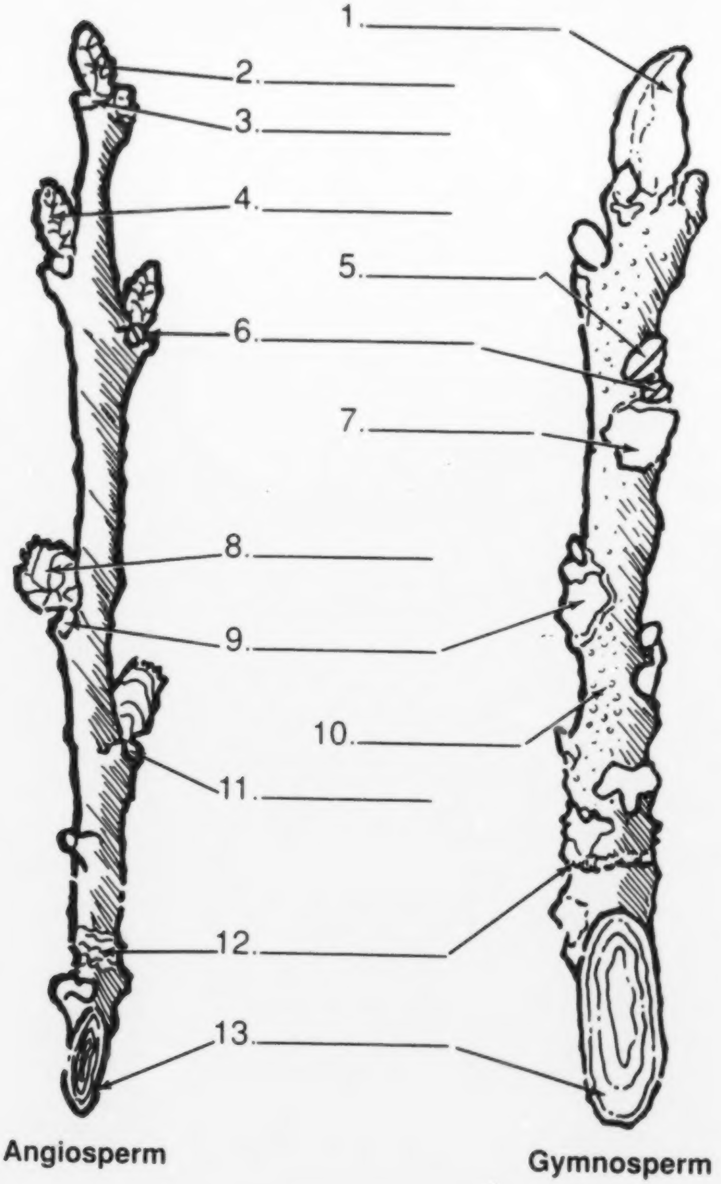
15. ____________



16. ____________

OBJECTIVE 9 **Label parts of a twig.** Write the correct letters in the blanks.

a. Bud scales
b. Bundle scar
c. False terminal bud
d. Flower bud
e. Lateral leaf buds
f. Leaf scars
g. Lenticel
h. Pith
i. Stipule scar
j. Superposed bud
k. Terminal bud scale scars
l. Terminal bud
m. Twig scar


1. ______
2. ______
3. ______
4. ______
5. ______
6. ______
7. ______
8. ______
9. ______
10. ______
11. ______
12. ______
13. ______
Angiosperm
Gymnosperm

OBJECTIVE 10 **Identify trees.** Write in the blanks the common names of trees indicated by your instructor.

1.________________________

2.________________________

3.________________________

4.________________________

5.________________________

6.________________________

7.________________________

8.________________________

9.________________________

10.________________________

11.________________________

12.________________________

13.________________________

14.________________________

15.________________________

16.________________________

17.________________________

18.________________________

19.________________________

20.________________________

NOTICE The following assignment sheets are not part of the written test. If these activities have not been completed, check with your instructor.

OBJECTIVE 11 **Compile a leaf and twig collection.** SCORE ________

OBJECTIVE 12 **Identify trees using a key.** SCORE ________

WRITTEN TEST ANSWERS

IDENTIFY FOREST TREES

V

OBJECTIVE 1

1. e
2. n
3. j
4. c
5. s
6. t
7. b
8. r
9. q
10. l
11. g
12. i

OBJECTIVE 2

1. a. B
   b. C
   c. B
   d. B
   e. C
   f. C
2. a. *Prunus americana*
   b. *Aesculus glabra arguta*
3. a. Sugar maple
   b. *Acer saccharum*
   c. Maple

OBJECTIVE 3

1. G
2. G
3. A
4. G
5. A
6. A
7. A
8. A
9. G
10. G
11. A
12. A
13. G
14. G
15. G
16. A
17. A
18. G

OBJECTIVE 4

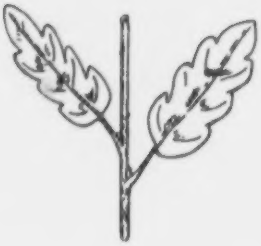
1. Twigs
2. Wood
3. Fruit
4. Leaves
5. Tree form
6. Bark

OBJECTIVE 5

1. Blade
2. Bud
3. Vein
4. Petiole
5. Midrib
6. Apex
7. Margin
8. Base

OBJECTIVE 6

1.



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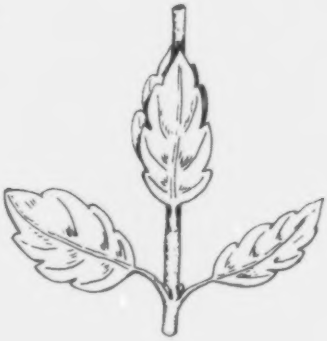

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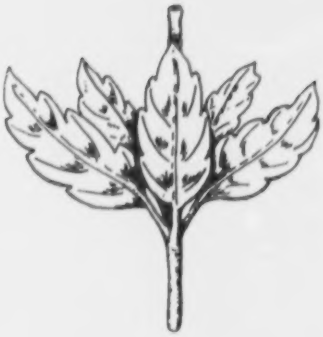
3.



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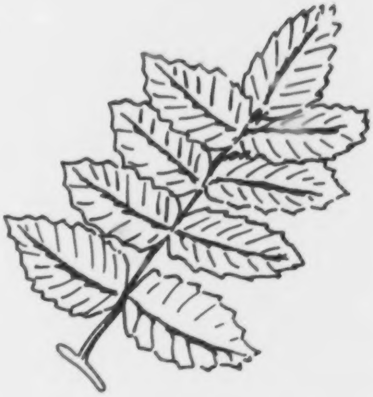

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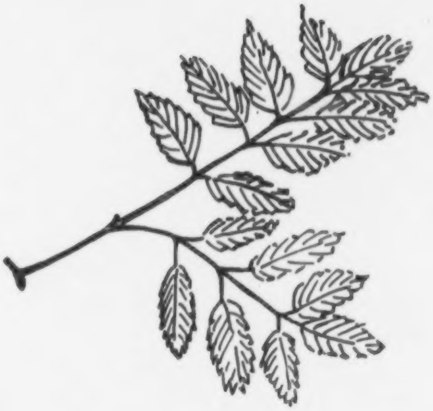

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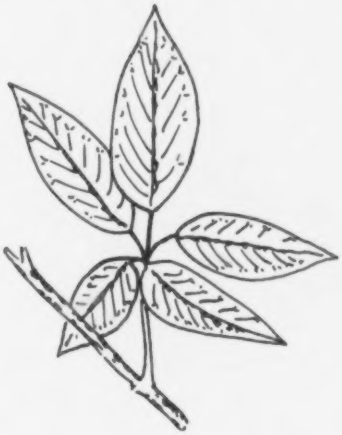

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OBJECTIVE 7

1. Obovate
2. Ovate
3. Lanceolate
4. Reniform
5. Cordate
6. Deltoid
7. Obdeltoid
8. Spatulate
9. Acicular
10. Scalelike
11. Linear
12. Oblong
13. Elliptical
14. Oval
15. Orbicular

OBJECTIVE 8

1. Cleft
2. Parted
3. Dentate
4. Serrate
5. Revolute
6. Entire
7. Repand
8. Sinuate
9. Lobed
10. Pinnately lobed
11. Palmately lobed
12. Serrulate
13. Doubly serrate
14. Divided
15. Crenate
16. Crenulate

OBJECTIVE 9

1. l
2. c
3. m
4. a
5. j
6. e
7. b
8. d
9. f
10. g
11. i
12. k
13. h

OBJECTIVE 10 Answers will vary according to the trees chosen by the instructor.

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.
13.
14.
15.
16.
17.
18.
19.
20.

OBJECTIVE 11 Refer to answers to Assignment Sheet 1.

OBJECTIVE 12 Refer to answers to Assignment Sheet 2.

OBJECTIVE SHEET

PRACTICE FOREST SAFETY

VI

INTRODUCTION

In all careers and at all work sites the most important rule is **Safety First**. Outdoor work has the built-in dangers of weather and wildlife. Accidents can happen out, away from help; even experienced foresters can get lost. Logging operations involve dangerous, heavy equipment. Knowing how to handle yourself in these situations, to keep yourself and others safe from injury, is a major responsibility.

UNIT OBJECTIVE

After completing this unit, the student should know basic safety practices for working in the forest and should be able to recognize forest dangers and the symptoms of heat injuries. The student will demonstrate these competencies by completing the assignment sheets and written test with a minimum of 100 percent accuracy.

PREREQUISITES

None

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with practicing forest safety to their correct definitions.
2. Choose the best word or phrase to complete statements about environmental hazards.
3. List proper clothing for the weather.
4. Complete statements about first aid and first-aid kits.
5. State jobsite safety practices.
6. Choose the best word or phrase to complete statements about provisions of the Federal Environmental Pesticide Control Act.
7. Discuss poisonous snakes.
8. Identify poisonous plants from a description.
9. Distinguish among insect and spider bites and their effects and prevention.
10. List measures to prevent heat stroke, heat cramps, and heat exhaustion.

11. Select from a list preventive measures and symptoms of hypothermia.

12. List precautions and procedures concerning getting lost.

13. Match forest dangers to their descriptions.

14. Identify poisonous snakes. (Assignment Sheet 1)

15. Present an informative speech about an insect or spider. (Assignment Sheet 2)

16. Distinguish among symptoms of heat stroke, heat cramps, and heat exhaustion. (Assignment Sheet 3)

SUGGESTED ACTIVITIES

PRACTICE FOREST SAFETY

VI

PREPARATION

- Obtain materials to supplement unit.

  NOTE: See Suggested Resources.

- Review instructional outline for this unit. Modify time frames to suit class needs and plan activities for each class period.

- Study the specific objectives to determine those you will cover in your presentation. Decide which objectives should be taught to which students.

- Determine scope and sequence of objectives that you add. Design and develop support materials, including evaluation techniques, for additional objectives.

- Determine how you will schedule time for students to demonstrate competence in the required procedures.

  NOTE: Allow students at least one week to prepare for their speeches in Assignment Sheet 3. Allow 10 minutes per student per class period for giving the speeches and the class critique.

- Make arrangements for guest speakers. Supply speakers with specific objectives and other appropriate sections of the unit.

  - Invite a panel of foresters to discuss safety with the class, supporting Objectives 1-13. Request panelists such as consultants, federal or state foresters, and loggers to discuss issues such as clothing, hazards, getting lost, and other forest dangers.

  - Invite a hearing aid salesperson to talk about damage to the ear and let students experience how sound is heard through a hearing aid.

  - Invite a physician or Emergency Medical Technician to discuss snake bite, insect bites and stings, heat stroke, heat cramps, heat exhaustion, hypothermia, and frostbite.

- Display safety posters to support the unit.

- Obtain a hearing aid for students to experience sound once hearing is damaged to support Objective 5.

- Order slide set *Venomous and Nonvenomous Snakes of Oklahoma.*
- Arrange for a field trip to a university or museum where students can see poisonous snakes to support Objective 7.
- Collect or have students collect insects discussed in this unit to support Objective 9. If the unit is to be taught in winter months, obtain pictures of particularly harmful insects in your area.
- Arrange to take students on a hike to an area with rough terrain and have them observe potential and real topographic hazards to support Objective 13.

DELIVERY

Objective 1

- Review terms with the class.
- Stress that safety is the most important part of any job.
- Ask students to imagine the effects of injury or accident and discuss reasons for practicing job safety:
  - Prevent physical harm to yourself and others
  - Avoid loss of work hours
  - Avoid loss of pay
  - Lower cost to employer
  - Prevent loss or damage of equipment or materials
  - Lower insurance rates
  - Prevent hardship on family
  - Provide regular job schedules
  - Prevent possible loss of job

Objective 2

NOTE: This objective is an overview of the ordinary problems foresters face in the woods. Equipment hazards are not covered.

- Share some experiences that you have had or heard about from others concerning heat, cold, insects, wildlife, and topographical hazards.

Objective 3

- Discuss how sweat cools the body in hot weather. Students can experiment by placing dry and wet hands in front of a fan.
- Discuss how the major loss of body heat in winter is from the top of the head. Make it very clear to students that if they are not properly dressed for cold they are in serious danger.
- Ask the class for their experiences in extreme heat and cold.

Objective 4

- Encourage students to take a Red Cross First-Aid class and CPR.
- Have students take an inventory of your first-aid kit, arrange it neatly, identify materials that are needed and offer suggestions for improvement, storage, carrying, etc.
- Visit another shop in the school and check out the first-aid kit.

Objective 5

- Share with students and ask them to share with the class experiences or stories of jobsite accidents and how they might have been prevented.
- Stress that safety practices are basic to any jobsite.
- Show the video *The Future is in Your Hands*.
- Show and demonstrate the use of protective clothing and devices.
- Invite an audiologist or hearing aid salesperson to discuss hearing loss. Obtain a hearing aid and let students hear what can happen when hearing is damaged.
- Have students make safety posters. This activity will give students with artistic, creative and verbal skills an opportunity to express themselves and will give students weak in these areas an opportunity to practice using them.

Objective 6

- Discuss pesticide-use safety, including proper storage, handling, and disposal.
- Show the videos *Chemical Safety I* and *Chemical Safety II*.

Objective 7

- Show slide set of poisonous snakes. You may supplement slide set with your own pictures, especially snakes common to your area.

  NOTE: The coral snake has not been found in Oklahoma.

- If possible, take a field trip to a zoo or university to see poisonous and nonpoisonous snakes.
- Ask students to share experiences they have had or heard about regarding snakes.
- Stress that rattlesnakes do not always rattle before striking.
- Have students complete Assignment Sheet 1 to gain practice in identifying poisonous snakes.

Objective 8

- Discuss the poisonous plants found in your area.
- Have students complete Activity Sheet 1. Let them share their answers with the class and discuss them.

Objective 9

- Show the video *Ticks and Lyme Disease*.
- Have students complete Assignment Sheet 2. Give students one week to prepare for the speech and allow 10 minutes per speaker to allow for class discussion and critique.
- Review the grading criteria for Assignment Sheet 2 during the introduction to this objective.

Objective 10

- Show Transparency Master 1 to familiarize students with the symptoms of heat stroke and heat exhaustion.
- Assign a student to find out average and extreme summer temperatures and average and extreme humidity readings for your area and to share that information with the class.
- Have the class figure the heat index (perceived heat) for averages and extremes in temperature and humidity.
- Have students complete Assignment Sheet 3 to provide practice in distinguishing among symptoms of heat stroke, heat cramps, and heat exhaustion.

Objective 11

- Assign a student to find out average and extreme winter temperatures, wind, and humidity readings for your area and to share that information with the class.
- Have the class figure the wind chill factor (perceived cold) for averages and extremes in temperature and wind velocity.
- Have a doctor or EMT talk to the class about hypothermia and frostbite.

Objective 12

- Refer to Unit X, *Use Basic Surveying Techniques*, for information on using a compass.
- Tell students they will receive detailed instruction in compass and map reading in Unit X.
- Stress the need for keeping calm when lost.
- Share and encourage students to share stories about being lost.

Objective 13

- Invite a panel of foresters to discuss their experiences and knowledge about forest safety. Ask them to discuss the types of accidents and hazards discussed in this objective.

- Take students on a hike to an area with rough terrain and have them identify, report and discuss the hazards they observe there. Encourage them to imagine and discuss possible accidents and emergency treatments.
- Refer students to Supplement 2.
- Plan a hypothetical weekend campout for which students survey their clothing and gear and determine what they already have and what they need.

APPLICATION

Objective 14

- Use Assignment Sheet 1 to give students experience in identifying poisonous and nonpoisonous snakes.
- Choose ten slides from the snake slide set, *Venomous and Nonvenomous Snakes of Oklahoma*, for students to identify for Assignment Sheet 1. Choose slides that clearly show characteristics of poisonous and nonpoisonous snakes. You may supplement with slides of your own.

  NOTE: You may want to give students bonus points for identifying the name of the snake.

Objective 15

- Use Assignment Sheet 2 to give students experience in researching and giving a speech.
- Photocopy Handout 1, *Student Evaluation Sheet*, and give one per speaker to each student. They are intended to encourage serious listening and may or may not be graded as desired.
- Use the Evaluation Form in Teacher Supplement 1 to grade the presentation.
- Give students the Speech Evaluation Sheet after speeches are graded.

Objective 16

- Use Assignment Sheet 3 to help students learn to distinguish among symptoms of heat stroke, heat cramps, and heat exhaustion.

EVALUATION

Written Test

- Explain to students that they will be asked to demonstrate on the written test actions listed in the specific objectives.
- Give written test.

  NOTE: The written test may be given in sections if desired.
- Evaluate students on assignment sheet activities if not previously done.
- Reteach and retest if necessary.
- Complete appropriate section of competency profiles.
- Review individual and group performance in order to evaluate teaching methods. Adjust scope, sequence, or instructional approaches for additional lessons as required.

SUGGESTED RESOURCES

Audiovisual Materials

- *Chemical Safety I*, 1/2" VHS, color, 20 min., Tel-A-Train, 1985. Available from Tel-A-Train, 309 N. Market St., Chattanooga, TN 37405, (615) 624-2628. Stresses the importance of understanding the potential hazards a chemical may present, and of maintaining a safe attitude around hazardous substances. The viewer is introduced to labels and material safety data sheets (MSDS), then given eight rules to follow when working with chemical substances.
- *Chemical Safety II*, 1/2" VHS, color, 21 min., Tel-A-Train, 1985. Available from Tel-A-Train, 309 N. Market St., Chattanooga, TN 37405, (615) 624-2628. The hazards of toxic exposure through inhalation, absorption, and ingestion are explained. The viewer is cautioned about situations which present special hazards, and the importance of using the proper mask or respirator.
- *The Future is in Your Hands*, 1/2" VHS, color, 15 min., Agency for Instructional Tech., 1986. Available from Agency for Instructional Tech., 1111 W. 17th Street, Bloomington, IN 47402, (800) 457-4509. The case history of Roy Keller, a hand accident victim, sets the stage for this highly motivational, award-winning program.

NOTE: The above videos are available to Oklahoma teachers on a free-loan basis from the Oklahoma Department of Vocational and Technical Education, Resource Center, ATTN: Instructional Media Specialist, 1500 West Seventh Avenue, Stillwater, OK 74074. Out-of-state teachers must order from the addresses listed with each video.

- *Ticks and Lyme Disease*, 18 min., U.S. Forest Service. Available from the Forestry Extension Program at Oklahoma State University, 242 Agricultural Hall, Stillwater, OK 74078, (405) 744-5444.
- *Venomous and Nonvenomous Snakes of Oklahoma*, 16 color slides. Available from Curriculum and Instructional Materials Center, Oklahoma Department of Vocational and Technical Education, 1500 West Seventh Avenue, Stillwater, OK 74074. Oklahoma teachers may call toll free (800) 522-5810, ext. 589. Out-of-state teachers may call toll free (800) 654-4502.

Publications

- Conant, Roger, *A Field Guide to Reptiles and Amphibians: Eastern and Central North America*, Houghton Mifflin Company, Boston, 1986.
- Criswell, Jim T., *First Aid for Pesticide Poisoning*, OSU Extension Facts No. 7453, Cooperative Extension Service, Division of Agriculture, Oklahoma State University, Stillwater, Oklahoma, n.d.
- Simon, Hilda, *Easy Identification Guide to North American Snakes*, Dodd, Mead, and Company, New York, 1979.
- Webb, Robert G., *Reptiles of Oklahoma*, University of Oklahoma Press, Norman, Oklahoma, 1970.

UNIT REFERENCES

- *Accident Prevention Manual of Industrial Operations*, 7th ed., National Safety Council, Chicago, Illinois, 1974.
- American Red Cross, *Standard First Aid and Personal Safety*, 2nd. Ed., 1979.
- Conant, Roger, *A Field Guide to Reptiles and Amphibians: Eastern and Central North America*, Houghton Mifflin Company, Boston, 1986.
- Hamilton, Jon, "Lyme Disease: Not Just Deer Ticks," in *American Health*, Vol. viii, No. 5, June, 1989, p. 13-14.

- Olson, David, *Basic Surveying Technology*. Mid-America Vocational Curriculum Consortium, Inc., Stillwater, Oklahoma, 1987.
- Perky, Sandra, *Highway Maintenance Equipment Operator*, Vol. 1, Curriculum and Instructional Materials Center, Oklahoma Department of Vocational and Technical Education, Stillwater, Oklahoma, 1983.
- Simon, Hilda, *Easy Identification Guide to North American Snakes*, Dodd, Mead & Company, New York, 1979.

SPEECH EVALUATION SHEET

Student's Name______________________________ Grade_____

	Excellent	Good	Fair	Poor	Not included
CONTENT INCLUDED					
The name of the insect	____	____	____	____	____
A description, including size, color, what it feeds on, how it bites or stings	____	____	____	____	____
Where it is found geographically	____	____	____	____	____
What kind of habitat it prefers	____	____	____	____	____
The effects of its sting or bite	____	____	____	____	____
Preventive measures and treatment	____	____	____	____	____
Other interesting details or important information	____	____	____	____	____
STRUCTURE INCLUDED					
An introduction to get the audience's attention	____	____	____	____	____
The body of the speech, containing all the information	____	____	____	____	____
Transitions to tie sections of the speech together	____	____	____	____	____
A conclusion that ends the speech clearly, so the audience knows the speech is over	____	____	____	____	____
DELIVERY					
Could be heard	____	____	____	____	____
Apparent willingness to share information with the audience (confidence)	____	____	____	____	____
Eye contact	____	____	____	____	____
Use of visual aid	____	____	____	____	____
Physical expressiveness (face, gestures, movement, ease)	____	____	____	____	____
Overall effectiveness					
Excellent - 4, Good - 3, Fair - 2, Poor - 1, Not included - 0					
Totals	____	____	____	____	____

HANDOUT 1 | **PRACTICE FOREST SAFETY** **VI**

STUDENT EVALUATION

Speaker ______________________ Subject ______________

Evaluator ______________________

When the speaker has taken his or her seat, please rate the speech on the following criteria:

	Excellent	Good	Fair	Poor	Not included
Introduction	____	____	____	____	____
Factual content					
Quantity	____	____	____	____	____
Quality	____	____	____	____	____
Organization	____	____	____	____	____
Transitions	____	____	____	____	____
Visual aid	____	____	____	____	____
Use of the visual aid	____	____	____	____	____
Eye contact	____	____	____	____	____
Could be heard	____	____	____	____	____
Movement & gestures	____	____	____	____	____
Conclusion	____	____	____	____	____

INFORMATION SHEET

PRACTICE FOREST SAFETY

VI

OBJECTIVE 1

Match terms associated with practicing forest safety to their correct definitions.

- **Accident**—Any suddenly occurring, unintentional event that causes injury or property damage
- **Anesthetic**—A substance that causes loss of the sense of pain or itching

  NOTE: A **topical anesthetic** is a substance applied to the skin to stop pain or itching.
- **Antiseptic**—A substance that prevents infection

  EXAMPLES: Alcohol, iodine, hydrogen peroxide
- **Elliptic**—Oval-shaped

  NOTE: The oval shape is called an ellipse (ee-LIPS).

- **Frostbite**—Tissue damage due to freezing of tissue fluids
- **Habitat**—The region where a plant or animal naturally grows or lives
- **Heat cramps**—Muscular pains and spasms due to loss of salt through sweating or to inadequate intake of salt
- **Heat exhaustion**—Fatigue, weakness, and sometimes collapse due to loss of body fluids through sweating and lack of adequate water intake
- **Heat stroke**—Immediate, life-threatening emergency in which the victim has extremely high body temperature and a failure of the sweating mechanism
- **Hypothermia**—Below-normal body temperature usually due to overexposure to low temperatures

  NOTE: "Hypo" means low or under.

- **Safety**—State or condition of being safe; freedom from danger, risk, or injury
- **Topical**—On the skin

OBJECTIVE 2

Choose the best word or phrase to complete statements about environmental hazards.

- **Heat**—Hot temperatures, especially when the humidity is high, can cause heat cramps, heat exhaustion, and heat stroke. Heat exhaustion is very common in the field. How susceptible you are to overheating depends on your body and a number of other factors.

  The best protection against heat is wearing the proper clothing, pacing yourself, and knowing the signs and symptoms of overheating.

  NOTE: See Objectives 3 and 10 and Assignment Sheet 3 for more information.

- **Cold**—Freezing temperatures, especially when combined with wind and high humidity, can cause mistakes in judgement, hypothermia, and frostbite.

  The best protection against cold is wearing proper clothing and knowing the signs of overexposure.

  NOTE: See Objective 11 for more information.

- **Insects**—Whether life-threatening or merely annoying, insects are a forester's frequent (if not constant) companions during the spring, summer, and fall. From gnats and ants to black-widow spiders and hornets, to mosquitoes and deer flies, you must always keep yourself protected and be aware of the dangers that insects present.

  The best protection against insects is education (knowing which insects are dangerous, how to avoid them, and what to do if bitten or stung), dressing properly, and using chemical repellents.

  NOTE: See Objective 9 for more information.

- **Wildlife**—While most wildlife will avoid humans and are not a threat, poisonous snakes are a serious danger. Most snake bites occur on the ankle and lower calf, so anyone working where snakes are abundant should always wear boots with tops and chaps or heavy trousers. Most mammals, such as bears and mountain lions, will leave people alone.

  The best defense against danger from wildlife, including snakes and insects, is to be alert, stay calm, wear the proper clothing, and use good judgement.

  NOTE: See Objectives 5 and 7 and Assignment Sheet 2 for more information.

- **Topographic hazards**—Variations in the terrain can cause accidents, even for the most attentive and aware people. Twisted or broken ankles are common because of uneven ground, holes, loose rocks, and other dangers. A fall into water in freezing temperatures can cause hypothermia, frostbite, or death. Roads or trails may be washed out. Slopes can be steeper than they look and difficult to travel, especially in snow conditions.

  Getting lost in unfamiliar terrain is not uncommon; because the terrain changes with the seasons, you can get lost in familiar territory.

  The best defense against topographic hazards is to recognize forest dangers, stay alert and practice safety.

  NOTE: See Objectives 12 and 13 for more information.

OBJECTIVE 3

List proper clothing for the weather.

The dangers of heat are sunburn, heat stroke, heat exhaustion, and heat cramps. The proper cold weather clothing protects you from hypothermia and frostbite.

Warm weather

- Long-sleeve shirts, especially in brush cover

  NOTE: Short-sleeve shirts expose you to sunburn, wind burn, insect bites, scratches, skin reactions, allergies, etc.

- Long-leg trousers

  NOTE: Long-leg trousers should **always** be worn.

- Safety shoes or high-lace field boots with hard toes
- Hat with a brim

  NOTE: Repeated sunburn, especially on your hands, face, and ears, can lead to skin cancer.

Cold weather

- Layers of clothing

  NOTE: You can add or remove layers as needed.

  EXAMPLE: Undershirt, long-sleeve shirt, sweater, jacket

- Thermal underwear, wool pants and insulated coveralls
- Insulated, waterproof boots with two pairs of socks

  NOTE: Carry an extra pair of dry socks

- Gloves or mittens

  NOTE: These should not be so bulky that they interfere with your ability to work nor so tight that they cut off your circulation.

- A warm hat that covers the ears
- A scarf or muffler

Extreme cold

- Outer clothing with hood that will repel wind and moisture
- Face mask to prevent frostbite of the ears and nose
- Insulated gloves or mittens with water and windproof covering

Wet weather

- Rain suit or poncho
- Waterproof boots

  NOTE: Rubber boots are hot, have hard bottoms and make your feet sweat. Felt liners and cotton socks make boots more comfortable.

- Rain hood or waterproof hat with a brim

OBJECTIVE 4

Complete statements about first aid and first-aid kits.

NOTE: First-aid training and a short course in CPR (Cardiopulmonary resuscitation is a basic emergency procedure consisting of artificial respiration and manual external heart massage) are wise investments for everyone.

- **First aid—Immediate, temporary care** given to the victim of an accident or sudden illness until the services of a physician can be obtained.
- First aid can prevent infection, give comfort and assurance to a victim, and in extreme cases can save an arm, a leg—or a life. Training is available through your local Red Cross office.
- First-aid kits are made for a wide variety of uses and range from pocket-size to large, industrial sizes. Supplies and materials should be replaced as needed.
- Industrial kits are usually painted Federal Safety Green with a cross.

  NOTE: Locate a first-aid kit in your shop.
- Kits should contain sterile dressings, prepared splints, and other emergency equipment ready for use before an accident occurs.

  EXAMPLES: Antiseptic to kill germs and bacteria
  Adhesive bandages for various-sized wounds
  Gauze pads, various sizes
  Gauze roller bandages
  Triangular bandages for large wounds and slings
  Scissors
  Tweezers
  Elastic bandages for sprains
  Pain relievers
  Snake bite kit

OBJECTIVE 5 **State jobsite safety practices.**

NOTE: Many accidents are caused by negligence—not paying attention to possible hazards, becoming distracted by inner thoughts instead of keeping your mind on the job, or carelessness. Accidents such as hitting the person beside you with your shovel or slicing your face with a chainsaw can almost always be prevented by staying alert and putting safety first.

- Stay alert.
- Conduct yourself in a safe manner - no horseplay.
- Actively look for potential hazards.

  EXAMPLES: Tools left where they can be stepped on, logging chains or cables on the ground, loose rock on the trail, low-hanging broken branches

- Be aware of the people working around you.

  NOTE: Know what they are doing, where they are working, and the possible accidents that might occur. Be ready to help.

- Follow standard company procedures at all times—safety is organization.
- Know the location of first-aid equipment and fire extinguishers.
- Use the proper tools for the job.
- Know the safety regulations for all equipment or tools you use.
- Stay at least 200 feet away from operating equipment unless you have a specific job.
- Never use alcohol or drugs around equipment.

  NOTE: "Drugs" include hay fever, headache, or other medications that make you drowsy.

- Report all defects in tools, supplies, and equipment to your immediate supervisor.
- Report all accidents to your supervisor, regardless of the nature or severity.

- Wear proper protective clothing for the situation:
  - Hard hat around equipment or logging operations
  - Safety glasses or goggles around flying debris
  - Chaps for leg protection

    EXAMPLES: While using a chainsaw, in areas with poisonous snakes
  - Ear protection around heavy equipment
  - Gloves when handling logs or tools with no moving parts

    WARNING: Never wear gloves when using equipment that can catch the glove and pull your hand into the equipment.
  - Bright yellow or orange vest or coveralls during hunting seasons

OBJECTIVE 6

Choose the best word or phrase to complete statements about provisions of the Federal Environmental Pesticide Control Act.

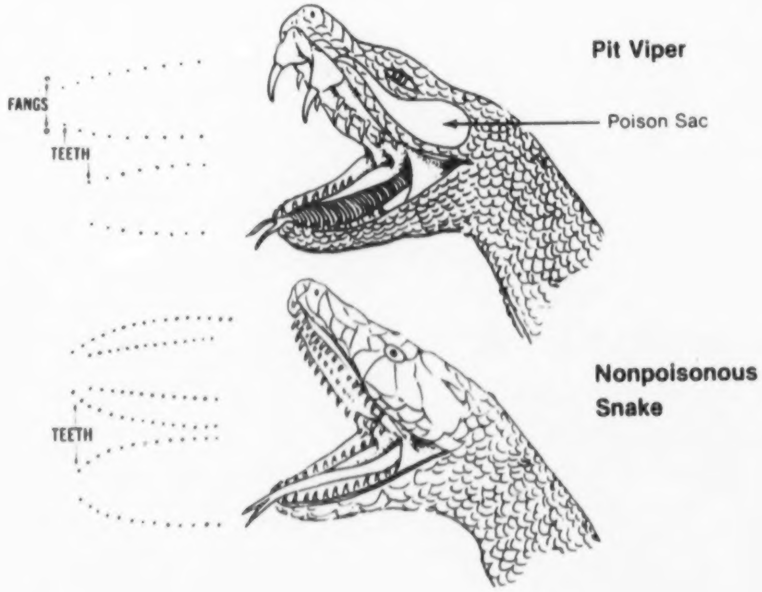
- All pesticide products must be registered with the EPA (Environmental Protection Agency).
- The use of any registered pesticide in a manner inconsistent with the label instructions is prohibited.
- All pesticides are classified as either "General Use Pesticides," which can be handled by the public or "Restricted Use Pesticides," which can be used only by or under supervision of certified personnel.
- The EPA sets minimum federal standards for the certification of restricted pesticides applicators, which are carried out by the states.

OBJECTIVE 7

Discuss poisonous snakes. (Assignment Sheet 1)

- **Pit vipers**—Copperheads, water moccasins (cottonmouths) and 13 species of rattlesnakes are related to the family of pit vipers (**Crotalidae**). Their poison affects the circulatory system (heart and blood flow). While the bite of a copperhead is usually not fatal, the cottonmouth and even small rattlesnakes are extremely dangerous. All pit vipers have:
  - A pit between the eye and nostril on each side
  - Vertically elliptic pupils
  - One to six fangs
  - Usually two well-developed fangs
  - One row of plates beneath the tail
  - Triangular shaped head with a narrow neck

  NOTE: All pit vipers have triangular or heart-shaped heads. However, there are some nonpoisonous water snakes with similar heads.



- **Coral snake**—A small snake whose venom affects the nervous system and is very toxic. Coral snakes have:
  - Tubular fangs
  - Round pupils
  - A double row of plates beneath the tail
  - Red, yellow, and black rings around the body with the red and yellow rings touching

    NOTE: Any snake in the eastern half of North America with red and yellow rings touching is venomous. An old saying goes "red and yellow kill a fellow."
  - A black nose

OBJECTIVE 8

Identify poisonous plants from a description.
(Activity Sheet 1)

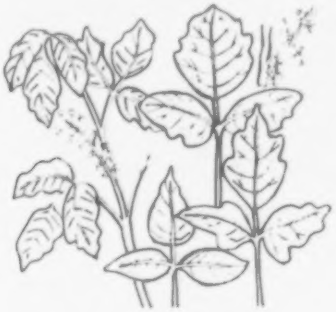
NOTE: The effects of poisonous plants can be headache, fever, itching, redness, and/or rash. Both poison ivy and poison oak have a series of three leaves, greenish-white flowers and whitish berries that grow in clusters. Poison ivy has glossy leaves. Stay away from both of them—they are poisonous all year around.

WARNING: Never burn poison oak or poison ivy. The smoke can blister the lungs, causing illness and sometimes death.

- **Common poison ivy** (*Rhus radicans*)
  - Grows as a small plant, a vine, and as a small or large shrub
  - Grows everywhere in the United States except California and parts of adjacent states

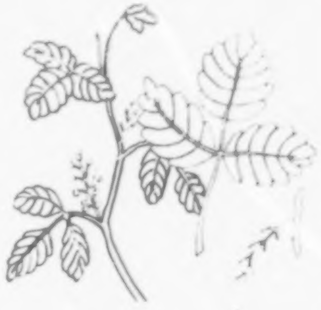
    NOTE: Eastern oak leaf poison ivy is one of its varieties.
  - Leaves always consist of three glossy leaflets

- Also known as three leaf ivy, poison creeper, climbing sumac, poison oak, milkweed, picry, and mercury



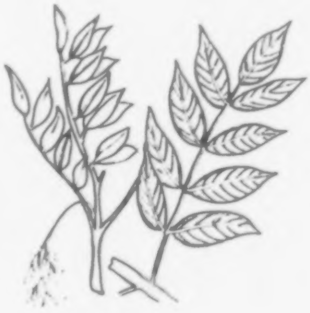
Poison Ivy

- **Western poison oak** (*Rhus diversiloba*)
  - Grows in shrub and sometimes vine form
  - Grows in California and parts of adjacent states
  - Sometimes called poison ivy, or yeara
  - Leaves always consist of three leaflets



Western Poison Oak

- **Poison sumac** (*Rhus vernix*)
  - Grows as a woody shrub or small tree from 5 to 25 feet tall
  - Grows in most of the eastern third of United States
  - Also known as swamp sumac, poison elder, poison ash, poison dogwood, and thunderwood



Poison Sumac

OBJECTIVE 9

Distinguish among insect and spider bites and their effects and prevention. (Assignment Sheet 2)

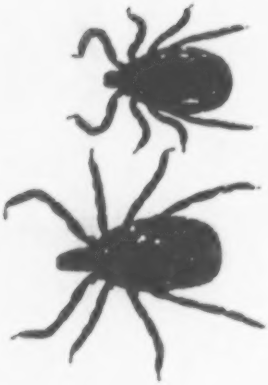
CAUTION: Always use an insect repellent, wear long-sleeve shirts and long pants. Tuck pants into socks and into boots.

- **Ticks**—Blood-sucking insects that burrow into the skin. If not properly treated, bite can become infected. Ticks are carriers of Rocky Mountain spotted fever and Lyme disease.

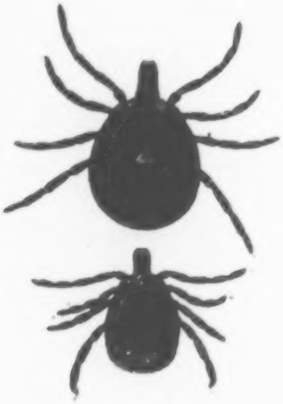
  NOTE: Rocky Mountain spotted fever causes high temperatures (103-105° F.) and severe headaches. Most people develop a characteristic spreading rash, beginning as flat red spots or splotches on the palms of the hands or soles of the feet. If the disease is not treated it can damage the kidney, liver, lungs and blood. The risk is greater if the tick has remained attached for several hours or if the tick is crushed while removing it.

Lyme disease is a very serious disease. Symptoms may start with a bull's-eye shaped rash, followed by flu symptoms. Months later paralysis, pain, arthritis, and birth defects may follow.

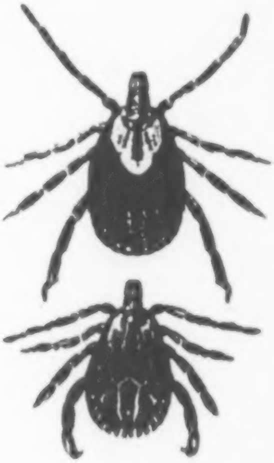
Ticks also transmit tick paralysis and other diseases to man, and a number of diseases to animals and birds. The Lone Star Tick below is a carrier of Rocky Mountain spotted fever, Tularemia and American Q fever.



Black-Legged Tick



Lone Star Tick



Gulf Coast Tick

Courtesy of the Department of Agricultural Communications, Oklahoma State University.

- **Prevention**—Check areas before sitting, particularly on logs and under trees. Use a repellent and follow directions. Keep pants tucked into socks; dust socks with sulphur powder.

- **Treatment**—Carefully remove ticks with tweezers immediately. Grab the tick as close to the skin as possible and pull gently straight out. Wash the area with soap and water. Use a topical antiseptic and for the next few weeks, watch for symptoms of Rocky Mountain spotted fever and Lyme disease.

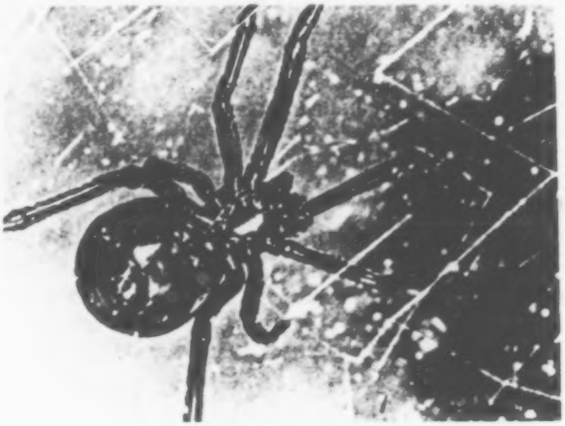
- **Stinging Insects**—Stings from ants, scorpions, bees, wasps, hornets and yellow jackets are painful but rarely serious. However, some people are acutely allergic to stings and have serious reactions, including shock and death.
  - **Prevention**—Check boots often if standing still, check area before sitting, avoid flying insects and stay calm in their presence. Shake out boots and clothing before dressing.
  - **Treatment**—Apply cold water or ice; a topical anesthetic may be used; take aspirin for pain.
- **Small insects**—Bites from fleas, mosquitoes, gnats, chiggers, and other insects produce local pain, itching and irritations but are not likely to be severe.

  NOTE: Mosquitoes, flies, and fleas have recently been found to carry Lyme disease.

  - **Prevention**—Use an insect repellent, wear a protective head net in heavily infested areas.
  - **Treatment**—Put cold water or ice on spot; use a soothing lotion such as aloe vera or calamine; a topical anesthetic may be used; avoid scratching.

- **Spiders**—Bites can cause a number of symptoms: minor-to-severe swelling, itching, nausea, blistering, and pain, but are generally not serious injuries. There are two notable exceptions:

  - **Black widow spider** (*Latrodectus mactans*)—Shiny black body with a red-to-orange hour glass shape on its abdomen. They are found around trash dumps or ash piles, under boxes, crates, stones and wood piles, and in outdoor restrooms. The black widow is considered the most venomous spider native to North America.

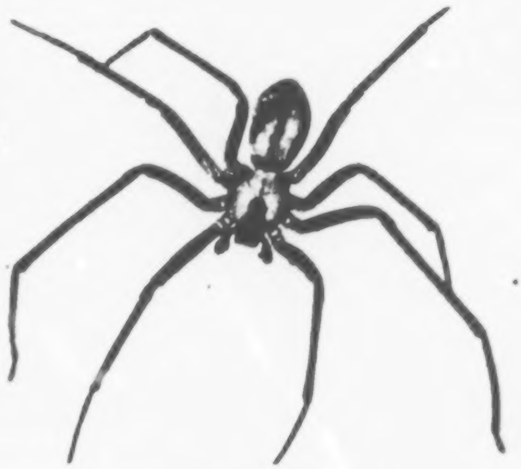


Black Widow Spider

Courtesy of the Department of Agricultural Communications, Oklahoma State University.

Symptoms—Bite looks like a pin prick; severe pain caused by nerve toxin starts within minutes and spreads throughout the body; profuse sweating, nausea, cramps; breathing and speaking are difficult.

- **Brown recluse** (*Loxosceles reclusa*)—Also called violin spider or fiddleback; color is tan to dark brown body with lighter brown head; dark "fiddle" on the back of the head. Found hiding in buildings, closets, old clothes, on the undersides of tables and chairs. Outside, they live under rocks and bark.



Brown Recluse

Courtesy of the Department of Agricultural Communications, Oklahoma State University.

Symptoms—A painful bite area swells and grows hard; blisters or ulcers will form; a rash over the body may occur within 24-48 hours. Within one to two weeks, the skin and muscle at the bite area slough off. Chills, fever, nausea and vomiting occur. Can leave severe scars.

- **Prevention**—Don't handle old logs or bark with bare hands; wear gloves to dig through dead leaves or to turn rocks or logs. Shake out clothing and bedding stored in closets and drawers.

- **Treatment**—Apply cold water or ice; a topical anesthetic may be used; take aspirin for pain; rest.

WARNING: Black widow and brown recluse spider bites are extremely dangerous. Seek medical attention immediately.

OBJECTIVE 10

List measures to prevent heat stroke, heat cramps, and heat exhaustion. (Transparency Master 1, Supplement 1, Assignment Sheet 3)

- Drink plenty of fluids.

  EXAMPLE: Sports drinks that replace electrolytes.

- Do not overexert.
- Wear lightweight clothing.
- Keep head covered and face shaded.
- Take frequent, short work breaks.
- Rest in shade whenever possible.

OBJECTIVE 11

Select from a list preventive measures and symptoms of hypothermia.

NOTE: The extent of injury caused by exposure to low temperatures depends on wind velocity, type and duration of exposure, temperature, and humidity. A person will freeze faster in wind and humidity or a combination of the two factors. Someone who has hypothermia once is likely to get it again easily when exposed to the cold.

- Preventive measures
  - Wear proper clothing.
  - Limit exposure as much as possible.

    NOTE: Limit the time you are out in the cold and the amount of skin exposed to cold and wind. The parts of your face most likely to get frostbite are your ears, your nose, and your cheekbones.

  - Take frequent, short rest periods.
  - Keep moving.

    NOTE: Exercise fingers and toes, if needed, but don't overexert.

  - Don't drink alcohol before exposure to cold.
  - Don't smoke before exposure.

  - Don't bathe before exposure.
  - Learn to recognize the symptoms of hypothermia and frostbite.
  - Warm cold hands by placing them under dry clothing against the body, such as in the armpits.

- **Symptoms**
  - Shivering
  - Numbness
  - Confusion

    NOTE: It is very easy to get disoriented and lost, even a short distance from camp when you have hypothermia. Sounds seem to come from all around, rather than from a single source. Memory is so poor that you can pass the same place several times without recognizing it.
  - Low body temperature
  - Drowsiness
  - Marked muscular weakness

OBJECTIVE 12

List precautions and procedures concerning getting lost. (Supplement 2)

NOTE: It is easy to get lost in the outdoors, even in familiar areas. Never take it for granted that you know where you are. Be alert and observant whenever you are out in open areas.

- Before entering the area
  - Tell someone in your organization where you will be
  - Obtain and carry a topographical map of the area
  - Talk to someone about local hazards

    EXAMPLE: Bluffs, dangerous wildlife, boggy areas
  - Carry plenty of water
  - Carry a compass and know how to use it

- On-site
  - Practice the Buddy System

    EXAMPLE: Keep visual or voice contact with your partner at all times

  - Notice landmarks

    NOTE: Take notes and compass readings.

  - Check compass against map often

- When lost

  NOTE: If, despite the use of a compass, map, and landmarks you become lost, do not panic. Stay calm. If you have told people where you were going and when you should return, they will know if you are missing. They will look for you.

  - Keep calm
  - Head downhill if no compass reading is available
  - Follow streams downstream

    NOTE: Roads are usually downslope, in the valleys.

OBJECTIVE 13

Match forest dangers to their descriptions.

NOTE: The greatest safety factor is knowledge. Being able to recognize forest dangers can help you avoid accidents and injury. As with all other hazardous conditions, stay alert, use caution and good judgment.

- **Bluffs**—Sudden drop-offs that may not be visible as you walk toward them
- **Rough terrain**—Traveling, working, and operating equipment is difficult and dangerous; exhaustion is a serious factor in accidents

  NOTE: Foresters may work on 40-50% slopes, which makes felling trees especially dangerous.

- **Loose rock**—Can cause twisted or sprained ankles; particularly dangerous on slopes
- **Snags**—Dead trees that are no longer solid

- **Dead tops of trees**—A portion of the tree is rotten and may be broken or loosely attached

  NOTE: Snags and dead tops of trees can fall as a result of wind, moving equipment, or even leaning against them. If the rotten part of a treetop is leaning or wedged against another tree when the tree is cut, the top will fall straight down, injuring or killing the person cutting the tree. The forestry slang for these and other dangerous trees is a "widowmaker."

- **Stump holes**—Cause broken legs and sprains

HEAT INJURY SYMPTOMS

CONDITION	SYMPTOMS
HEAT STROKE	Visual disturbances
WARNING: Heat stroke is an immediate, life-threatening emergency urgently requiring medical attention.	Headache, nausea
	High body temperature (may be as high as 106° F)
	Hot, flushed, dry skin
	Strong, rapid pulse
	Slow, deep breathing
	Offensive body odor
	Possible convulsions
	Possible loss of consciousness
HEAT CRAMPS	Abdominal pain
(NOTE: May precede an attack of heat exhaustion.)	Nausea, dizziness
	Pale skin
	Heavy sweating
	Muscular twitching
	Severe muscle cramps
HEAT EXHAUSTION	Approximately normal body temperature
	Pale, clammy skin
	Heavy sweating
	Nausea, possible vomiting
	Weakness, tiredness
	Fast, weak pulse
	Possible fainting
	(**NOTE**: victim will probably regain consciousness as head is lowered.)

SAFETY RULES FOR BACK COUNTRY TRAVEL

- Plan ahead, select safe routes, watch out for changes in ground surface, slick spots, or unusual hazards.
- Select each stepping spot carefully and do not shift body weight until you are sure the spot is solid.
- Know how to fall to avoid hard impacts. Keep flexible with knees slightly bent. If you feel yourself slipping, pick a landing spot. **Do not stick your arms out to break a fall.** Roll with the fall.
- In heavy undergrowth, lift your knees high to clear obstacles. Slow down and exaggerate steps in the area of exposed roots to keep from catching your toes.
- Avoid walking on logs unless they have been tested for secure footing.
- On slippery, loose ground, or when going downhill, keep most of your weight on your heels. Shorten your stride, keep knees bent, and lean slightly backward.
- When moving uphill or in sandy soils, lean slightly forward, turn feet outward, shorten stride, and use as much of the inside of the foot as possible.
- It is not recommended that you travel alone in back country. Should it be necessary to travel alone, make sure someone knows where you are going and when you are expected to return.

Back Country Travel

- Equipment. Recommended equipment when traveling in back country:
  - First-aid kit for the local area
  - Snakebite kit, if in snake country
  - Compass and map
  - Matches, in a waterproof container
  - Pocketknife
  - Belt ax
  - Flashlight
  - Day's supply of food, preferably concentrated
  - Lightweight shelter, poncho, space blanket
  - Signal mirror
  - Canteen, water, and small quantity of water purifier
- Conditions. Get a reliable check on expected weather and road conditions for the area. Get briefing about activity, equipment, limitations, and known or potential hazards.

Use good judgment - choose safe travel routes and stream crossings by scouting the area. Avoid traveling or camping in snag or rock slide areas in windy weather.

- Campsite Selection. Choose campsites in areas free of:
  - Unsound trees or limbs
  - Danger from rolling rocks
  - Dangers of flash flooding
- Rules for Working and Walking. **Make sure of secure footing and safe working positions. Walk—never run —down slopes.** Watch your step. Rocky slopes, especially slide rock and steep country, are treacherous. Have one hand free, preferably on the uphill side, for protection against falls or obstructions. Always carry tools on downhill side.

Always be on guard against injury from falling trees, snags, limbs, rolling logs, or rocks. Never run blindly if a rolling rock, log, or tree is heard. Try to determine the direction of fall, then move out of the path.

Maintain safe walking and working distance between people (10 feet minimum).

Be sure other workers in vicinity know where you are.

Wear tempered sunglasses or safety eyeware in brush or snow country.

- If lost, keep calm, don't panic. Select a warm shelter. Shelter, warmth, and liquids are much more important than food. Select sheltered spot and prepare camp, shelter, and firewood well before dark.

Check the surrounding country and attempt to orient yourself. Do not walk aimlessly. Carry and trust the map and compass.

If you can reach a road, trail, or telephone line, follow it until you can determine you are moving in the right direction. As a last resort, travel downhill parallel to a stream or drainage.

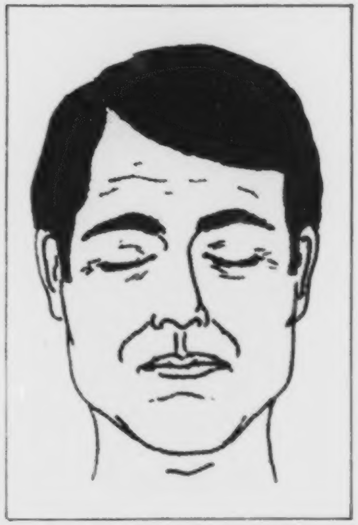
If unsuccessful in attempts to find your way, stay in one place, conserve your strength, and build a fire so that smoke may be seen by searchers. If signal mirror or portable radio is available, have it ready for immediate use.

Travel in Snowslide Areas

- **Avoid hazardous areas. In the spring, snowslide hazards can be extreme after 3 days of unusually hot weather.**
- Stay out of snow country for approximately 48 hours after heavy snowstorms or until the new snow bonds with the old.
- Be aware of the importance of traveling over snow areas during the early morning hours in the spring or during periods of heavy thawing. Wet-snow avalanche hazard increases greatly after 12 noon.
- Know amount of daylight available, time of sunrise and sunset.
- Get an early start and make camp early preferably by 3 p.m., in deep snow and cold weather.
- Carry a survival kit.

Face and Skin Conditions in Heat Stroke and Heat Exhaustion

Heat Stroke



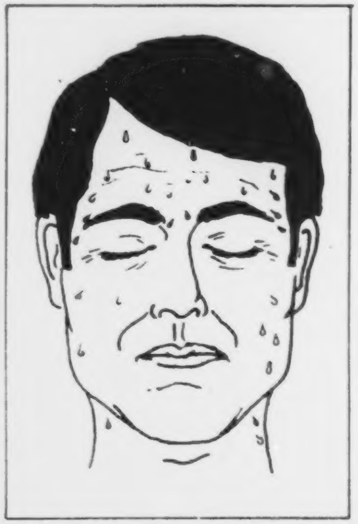
Skin Condition

Hot Red Dry

Get Immediate Medical Help

Cool body as quickly as possible

Heat Exhaustion



Skin Condition

Clammy Pale Heavy Sweating

Get victim out of sun and heat, elevate feet, cool body, give sips of salt water

TRANSPARENCY MASTER 1 - Forestry
VI - 43

TM 1

DISCUSS POISONOUS PLANTS

Answer the following questions on poison ivy, poison oak and poison sumac.

1. I have had a reaction to one of these plants. Yes____ No____

   If you checked "yes," which plant? ____________________

   Describe what happened to your body and how it felt. ____________________

   ____

   ____

   ____

   How long did it take to go away? ____________________

2. Using the pictures in Objective 8, describe in your own words what each one looks like.

   Poison Ivy ____________________________________

   ____

   Poison Oak ____________________________________

   ____

   Poison Sumac ____________________________________

   ____

3. Go to the school library or to your classroom dictionary and look up these plants. Add any new information below.

   Poison Ivy ____________________________________

   ____

   Poison Oak ____________________________________

   ____

   Poison Sumac ____________________________________

   ____

ASSIGNMENT SHEET 1

PRACTICE FOREST SAFETY

VI

NAME ______________________ SCORE ________

OBJECTIVE 14 **Identify poisonous snakes.**

INTRODUCTION Stings and bites are one of the most common hazards of outdoor work, especially in the woods. As with all the dangers discussed in this unit, the best defense is knowledge—being able to identify and keep away from snakes, plants, and insects that can hurt you.

DIRECTIONS Your instructor will show slides of snakes. Identify the snakes as poisonous or nonpoisonous and write down how you know whether the snake is poisonous or nonpoisonous.

1. ______________________________________
____
____

2. ______________________________________
____
____

3. ______________________________________
____
____

4. ______________________________________
____
____

5. ______________________________________
____
____

6. ____

____

____

7. ____

____

____

8. ____

____

____

9. ____

____

____

10. ____

____

____

ASSIGNMENT SHEET 2

PRACTICE FOREST SAFETY

VI

NAME ______________________________ SCORE ________

OBJECTIVE 15

Present an informative speech about an insect or spider.

INTRODUCTION

As you learned in Objective 9, there are many insects that can cause discomfort to people working out in the woods and weather. There are too many insects for you to study about the habitat and dangers of each one. However, if every person in the class shares this responsibility, then each one has to research only one insect or spider.

DIRECTIONS

Prepare a 2-3 minute speech to inform on one of the insects listed below.

Ticks
Ants
Scorpions
Bees
Wasps
Hornets
Yellow jackets
Fleas
Mosquitoes
Gnats
Chiggers
Black widow spider
Brown recluse spider

- **Cover at least these points:**
  - The name of the insect
  - A description, including size, color, what it feeds on, and how it bites or stings
  - Where it is found geographically
  - What kind of habitat it prefers
  - Include a visual aid such as a picture from a book, a drawing, photograph, slide, transparency or other visual aid showing the insect
  - The effects of its sting or bite
  - Preventive measures and treatment
  - Any other interesting details or important information

- **The speech must include:**
  - An introduction that gets the audience's attention

    EXAMPLES: An interesting or startling fact, a personal experience, a detailed description of the worst effects of the bite or sting, a thought-provoking question or action. Be creative: "Have you ever been bitten by a mosquito?" doesn't really get the audience's attention. A short quiz, joke or story related to the insect are all good attention-getters.
  - The body of the speech, containing all the information
  - An organization pattern that proceeds logically by subject matter, time (early, late, year, etc.), sequence (1st, 2nd 3rd steps or stages), or other clearly related pattern
  - Transitions that tie sections of the speech together

    EXAMPLES: "Another (or "The second") interesting feature of mosquitoes is ..."

    After you have talked about the small size of the mosquito, a good transition might be, "The mosquito may be small, but it's bite can raise a welt as big as a bee sting." Then go on to talk about the effects of a mosquito bite—itching, redness, swelling; how the mosquito squirts a coagulant into the blood. . ..
  - A conclusion that ends the speech clearly, so the audience knows the speech is over
- **A good delivery means:**
  - You can be heard
  - You seem willing to share information with the audience (confidence)
  - You have good eye contact and are not reading your speech, but actually talking to the audience
  - You use your visual aid well
  - You use your face, hands, and body as part of your communication with the audience

HINTS FOR A SUCCESSFUL AND ENJOYABLE SPEECH FOR YOU AND YOUR AUDIENCE

1. Be prepared. Know your speech and have it well practiced. Nothing succeeds like knowing you can do it well.
2. DO NOT READ your speech. Notes are better for most people, once you know your topic.
3. Be natural and use your face and hands to emphasize just as you do in your normal speech to your friends and family. Whenever you **feel like moving**, use a gesture, take a step forward or back, lean toward your audience or stand straight. Our instincts about moving while speaking are usually right—and that makes the difference between a "stiff" performance and a "natural" performance. Use neither too little movement nor too much. Practice until you feel comfortable.
4. Stage fright is normal. After you have spoken for about 10 seconds the nervousness begins to go away. If you've practiced, you might find you enjoy making the speech.
5. You will do better if you make sharing your information more important than how you look or feel. Once you forget about yourself and think about your topic and your audience, your speech will go quickly and easily.
6. When you make a mistake, correct yourself—laugh with the audience if it's a funny mistake, and go on. Even if you feel terrible, go on and don't let your discomfort show. Your audience wants you to succeed and doesn't want to see you be embarrassed.
7. Listen attentively to the other speakers. If you treat each other with respect, you will all have an easier, more enjoyable experience.

ASSIGNMENT SHEET 3

PRACTICE FOREST SAFETY

VI

NAME ______________________ SCORE ______

OBJECTIVE 16 **Distinguish among symptoms of heat stroke, heat cramps, and heat exhaustion.**

INTRODUCTION Since much of a forester's work takes place in the spring and summer months, knowing how to recognize the signals of overheating and how to take care of yourself and your partner can keep you safe and may help you save a life.

DIRECTIONS Use the chart in Supplement 1 to find the correct information. Write an X in the correct column or columns.

Symptoms	Heat Stroke	Heat Cramps	Heat Exhaustion
1. Heavy sweating	____	____	____
2. Leg muscle cramps	____	____	____
3. Weakness, tiredness	____	____	____
4. Strong, rapid pulse	____	____	____
5. Nausea	____	____	____
6. Hot, dry skin	____	____	____
7. Fainting, relieved by lowering the head	____	____	____
8. Headache	____	____	____
9. High body temperature	____	____	____
10. Pale, clammy skin	____	____	____
11. Loss of consciousness, cannot be roused	____	____	
12. Abdominal pain	____	____	____
13. Approximately normal body temperature	____	____	____
14. Flushed skin	____	____	____

ASSIGNMENT ANSWERS

PRACTICE FOREST SAFETY

VI

ASSIGNMENT SHEET 1

Students should have identified each snake as poisonous or nonpoisonous according to the slide shown. Students should also have stated how they knew whether the snake was poisonous or nonpoisonous. Extra points may be awarded if students can identify the snake.

ASSIGNMENT SHEET 2

Evaluated according to the criteria on Teacher Supplement 1 - Speech Evaluation Sheet. Students' evaluations may or may not be graded.

ASSIGNMENT SHEET 3

1. Exhaustion, cramps
2. Cramps (student may include exhaustion)
3. Exhaustion
4. Stroke
5. Stroke, cramps, exhaustion
6. Stroke
7. Exhaustion
8. Stroke
9. Stroke
10. Exhaustion
11. Stroke, exhaustion
12. Cramps (student may include exhaustion)
13. Exhaustion
14. Stroke

WRITTEN TEST

PRACTICE FOREST SAFETY

VI

NAME ________________________________ SCORE ________

OBJECTIVE 1

Match terms associated with practicing forest safety to their correct definitions. Write the correct letters in the blanks.

____ 1. On the skin

____ 2. Below-normal body temperature usually due to overexposure to low temperatures

____ 3. The region where a plant or animal naturally grows or lives

____ 4. Oval-shaped

____ 5. A substance that causes loss of the sense of pain or itching

____ 6. A substance that prevents infection

____ 7. Immediate, life-threatening emergency in which the victim has extremely high body temperature and a failure of the sweating mechanism

____ 8. State or condition of being safe; freedom from danger, risk, or injury

____ 9. Muscular pains and spasms due to loss of salt through sweating or to inadequate intake of salt

___ 10. Any suddenly occurring, unintentional event that causes injury or property damage

___ 11. Tissue damage due to freezing of tissue fluids

___ 12. Fatigue, weakness, and sometimes collapse due to loss of body fluids through sweating and lack of adequate water intake

a. Accident
b. Anesthetic
c. Antiseptic
d. Catastrophe
e. Den
f. Elliptic
g. Frostbite
h. Habitat
i. Heat cramps
j. Heat exhaustion
k. Heat stroke
l. Hyperthermia
m. Hypothermia
n. Overexposure
o. Safety
p. Security
q. Superficial
r. Topical

OBJECTIVE 2

Choose the best word or phrase to complete statements about environmental hazards. Write the correct answer or answers in the blank.

____ 1. Of the following defenses against insects, the LEAST effective would be __________ .

a. education

b. chemical repellents

c. dressing properly

d. frequent movement

____ 2. Cold hazards are common when freezing temperatures combine with __________ .

a. wind and high humidity

b. still, moist air

c. extremely dry conditions

d. wind and low humidity

____ 3. The most common heat hazard in the field is __________ .

a. Heat stroke

b. Heat cramps

c. Heat exhaustion

____ 4. Topographic hazards can cause accidents and __________ .

a. hallucinations

b. loss of direction

c. hypothermia

d. nausea

____ 5. In the presence of high temperatures, heat stroke, heat cramps or heat exhaustion are most likely to occur in a __________ .

a. desert

b. timber stand

c. prairie

d. marsh

____ 6. Most snake bites occur __________ .

a. on the ankle and lower calf

b. on the hand

c. on the buttocks

d. on the thigh

OBJECTIVE 3

List proper clothing for the weather.

1. Warm weather. List three items.

____

____

____

2. Cold weather. List four items.

____

____

____

____

3. Extreme cold. List two items.

____

____

4. Wet weather. List two items.

____

____

OBJECTIVE 4

Complete statements about first aid and first-aid kits. Write the correct words or phrases in the blanks.

1. Care given to the victim of an accident or sudden illness until the services of a physician can be obtained is called _______.
2. First-aid training is available from your local _______________________________ .
3. Industrial first-aid kits are usually painted _______________________________.
4. Kits should contain sterile dressings, prepared splints, and other emergency equipment ready for use_______________________________ .

OBJECTIVE 5

State jobsite safety practices. List ten safety practices.

OBJECTIVE 6

Choose the best word or phrase to complete statements about provisions of the Federal Environmental Pesticide Control Act. Write the correct answer in the blank.

____ 1. The use of any registered pesticide in a manner inconsistent with the label instructions __________.

a. is prohibited

b. is punishable by 3-year imprisonment

c. will probably cause serious illness or death

d. is not advised

____ 2. If you wanted to be a certified pesticide applicator, you would take training and a test given by the __________.

a. EPA

b. county extension agent

c. state

d. manufacturer

____ 3. All pesticide products must be registered with the __________.

a. EPA

b. USDA

c. Forest Service

d. FEPCA

____ 4. The pesticides that can be handled only by or under supervision of certified personnel are labeled __________.

a. Certified Use Pesticides

b. Registered Use Pesticides

c. Classified Use Pesticides

d. Restricted Use Pesticides

OBJECTIVE 7

Discuss poisonous snakes.

1. Give three examples of snakes which belong to the family of pit vipers.

____

____

____

2. What part of the body is affected by pit viper venom?

____

3. Describe five characteristics of pit vipers.

4. What part of the body is affected by coral snake venom?

5. Describe four characteristics of coral snakes.

OBJECTIVE 8

Identify poisonous plants from a description. Write the correct names in the blanks.

1. ______________________________

- Grows in shrub and sometimes vine form
- Grows in California and parts of adjacent states
- Leaves always consist of three leaflets

2. ______________________________

- Grows as a woody shrub or small tree from 5 to 25 feet tall
- Grows in most of the eastern third of United States

3. ______________________________

- Grows as a small plant, a vine, and as a small or large shrub
- Grows everywhere in the United States except California and parts of adjacent states
- Leaves always consist of three glossy leaflets

OBJECTIVE 9

Distinguish among insect and spider bites and their effects and prevention. Write the correct letter or letters in the blanks.

"ST" if the statement concerns STINGING INSECTS

"SI" if the statement concerns SMALL INSECTS

"T" if the statement concerns TICKS

"BW" if the statement concerns BLACK WIDOW SPIDERS

"BR" if the statement concerns BROWN RECLUSE SPIDERS

PART I

____ 1. These insects are primary carriers of Rocky Mountain spotted fever and Lyme disease.

____ 2. A painful bite area swells and grows hard; blisters or ulcers will form; a rash over the body may occur within 24-48 hours. Within 1 to 2 weeks, the skin and muscle at the bite area slough off. Chills, fever, nausea and vomiting occur. Can leave severe scars.

____ 3. Blood-sucking insects that burrow into the skin. If not properly treated, bite can become infected.

____ 4. Are painful but rarely serious. However, some people are acutely allergic and have serious reactions, including shock and death.

____ 5. Produce local pain, itching and irritations but are not likely to be severe.

____ 6. Bite looks like a pin prick; severe pain caused by nerve toxin starts within minutes and spreads through the body; profuse sweating, nausea, cramps; breathing and speaking are difficult.

PART II

Prevention

____ 1. Don't handle old logs or bark with bare hands; wear gloves to dig through dead leaves or to turn rocks or logs.

____ 2. Use an insect repellent, wear a protective head net in heavily infested areas.

____ 3. Check areas before sitting, particularly on logs and under trees. Use a repellent and follow directions. Keep pants tucked into socks; dust socks with sulphur powder.

____ 4. Check boots often if standing still, check area before sitting; avoid flying insects and stay calm in their presence. Shake out boots and clothing before dressing.

OBJECTIVE 10

List measures to prevent heat stroke, heat cramps, and heat exhaustion. Write five preventive measures.

____

____

____

____

____

____

OBJECTIVE 11

Select from a list preventive measures and symptoms of hypothermia. Write an "X" in the blank before each correct answer.

PART I

Preventive measures

____ 1. Drink hot liquids laced with alcohol

____ 2. Learn to recognize the symptoms of hypothermia and frostbite

____ 3. Don't bathe before exposure

____ 4. Don't drink alcohol before exposure to cold

____ 5. Don't eat before exposure

____ 6. Limit movement to conserve energy

____ 7. Wear proper clothing

____ 8. Keep moving

____ 9. Limit exposure as much as possible

____ 10. Keep working to keep warm

PART II

Symptoms

____ 1. Slight muscular weakness

____ 2. Brightness of the eyes

____ 3. Hallucinations

____ 4. Numbness

____ 5. Redness of the eyes

____ 6. Tingling

____ 7. Drowsiness

____ 8. Goose bumps

____ 9. Confusion

____ 10. Low body temperature

____ 11. Marked muscular weakness

____ 12. Shivering

OBJECTIVE 12 **List precautions and procedures concerning getting lost.**

1. Before entering the area. List four precautions and procedures.

2. On-site. List three precautions and procedures.

____

____

____

3. When lost. List three precautions and procedures.

____

____

____

OBJECTIVE 13

Match forest dangers to their descriptions. Write the correct letters in the blanks.

____1. Traveling, working, and operating equipment is difficult and dangerous; exhaustion is a serious factor in accidents

____2. Cause broken legs or sprains

____3. Dead trees that are no longer solid

____4. A portion of the tree is rotten and may be broken or loose

____5. Sudden drop-offs that may not be visible as you walk toward them

____6. Can cause twisted or sprained ankles; particularly dangerous on slopes

a. Animal dens

b. Avalanche

c. Bluffs

d. Dead tops of trees

e. Loose rock

f. Potholes

g. Rotters

h. Rough terrain

i. Snags

j. Stump holes

NOTICE

The following assignment sheets are not part of the written test. If these activities have not been completed, check with your instructor.

OBJECTIVE 14

Identify poisonous snakes. SCORE ________

OBJECTIVE 15

Present an informative speech about an insect or spider. SCORE ________

OBJECTIVE 16

Distinguish among symptoms of heat stroke, heat cramps, and heat exhaustion. SCORE ________

WRITTEN TEST ANSWERS

PRACTICE FOREST SAFETY

VI

OBJECTIVE 1

1. r
2. m
3. h
4. f
5. b
6. c
7. k
8. o
9. i
10. a
11. g
12. j

OBJECTIVE 2

1. d
2. a
3. c
4. c
5. d
6. a

OBJECTIVE 3

1. Answer should include any three of the following:
   - Long-sleeve shirts
   - Long-leg trousers
   - Safety shoes or high-lace field boots with hard toes
   - Hat with a brim
2. Answer should include any four of the following:
   - Layers of clothing
   - Thermal underwear, wool pants, and insulated coveralls
   - Insulated, waterproof boots with two pairs of socks
   - Gloves or mittens
   - A warm hat that covers the ears
   - A scarf or muffler

3. Answer should include any two of the following:

   - Outer clothing with hood that will repel wind and moisture
   - Face mask to prevent frostbite of the ears and nose
   - Insulated gloves or mittens with waterproof and windproof covering

4. Answer should include any two of the following:

   - Rain suit or poncho
   - Waterproof boots
   - Rain hood or waterproof hat with a brim

OBJECTIVE 4

1. First-aid
2. Red Cross Office
3. Federal Safety Green
4. before an accident occurs

OBJECTIVE 5

Answer should include any ten of the following:

- Stay alert.
- Conduct yourself in a safe manner - no horseplay.
- Actively look for potential hazards.
- Be aware of the people working around you.
- Follow standard company procedures at all times—safety is organization.
- Know the location of first-aid equipment and fire extinguishers.
- Use the proper tools for the job.
- Know the safety regulations for all equipment or tools you use.
- Stay at least 200 feet away from operating equipment unless you have a specific job.

- Never use alcohol or drugs around equipment.
- Report all defects in tools, supplies, and equipment to your immediate supervisor.
- Report all accidents to your supervisor, regardless of the nature or severity.
- Wear proper protective clothing for the situation.

OBJECTIVE 6

1. a
2. c
3. a
4. d

OBJECTIVE 7

1. Copperheads, water moccasins (cottonmouths) and rattlesnakes
2. Circulatory system (heart and blood)
3. Answer may include any five of the following:
    - A pit between the eye and nostril on each side
    - Vertically elliptic pupils (accept either vertical or elliptical)
    - One to six fangs
    - Usually two well-developed fangs
    - One row of plates beneath the tail
    - Triangular shaped head with a narrow neck
4. The nervous system
5. Answer should include any four of the following:
    - Tubular fangs
    - Round pupils
    - Double row of plates beneath the tail
    - Red, yellow, and black rings around the body with the red and yellow rings touching

- Black nose

OBJECTIVE 8

1. Poison oak
2. Poison sumac
3. Poison ivy

OBJECTIVE 9

PART I

1. T
2. BR
3. T
4. ST
5. SI
6. BW

PART II

1. BW, BR
2. SI
3. T
4. ST

OBJECTIVE 10

Answer should include any five of the following:

- Drink plenty of fluids.
- Do not overexert.
- Wear lightweight clothing.
- Keep head covered and face shaded.
- Take frequent, short work breaks.
- Rest in shade whenever possible.

OBJECTIVE 11

PART I

2, 3, 4, 7, 8, 9

PART II

4, 7, 9, 10, 11, 12

OBJECTIVE 12

1. Answer should include any four of the following:
   - Tell someone in your organization where you will be.
   - Obtain and carry a topographical map of the area .
   - Talk to someone about local hazards.
   - Carry plenty of water.
   - Carry a compass.
2. Answer should include the following:
   - Practice the Buddy System.
   - Notice landmarks.
   - Check compass against map often.
3. Answer should include the following:
   - Keep calm.
   - Head downhill if no compass reading is available.
   - Follow streams downstream.

OBJECTIVE 13

1. h
2. j
3. i
4. d
5. c
6. e

OBJECTIVE 14	Refer to answers to Assignment Sheet 1.
OBJECTIVE 15	Refer to answers to Assignment Sheet 2.
OBJECTIVE 16	Refer to answers to Assignment Sheet 3.

OBJECTIVE SHEET

IDENTIFY AND USE BASIC TOOLS OF FORESTRY

VII

INTRODUCTION

Every kind of work has tools to increase human power and effectiveness. The hand tools used in forestry are generally simple, straightforward tools such as shovels, axes, knives and rakes, with a number of specialized tools for cutting and handling timber. A wide variety of power equipment is used in today's highly technological forestry operations, from chainsaws to feller-bunchers that can cut 25 acres in a day. Learning about the tools of forestry and how to use them correctly and safely can help you gain skills that will be useful for many outdoor activities.

PREREQUISITES

None

UNIT OBJECTIVE

After completing this unit, the student should be able to recognize hand tools and power equipment and their uses, and know safety procedures and safety equipment. The student will demonstrate these competencies by completing the assignment sheets, job sheets, and written test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with the basic tools of forestry to their correct definitions.
2. Match tools to their uses.
3. State safety rules for using hand tools.
4. Select from a list true statements about correct use of the body to avoid injuries.
5. State procedures for maintaining hand tools.
6. Match types of power equipment to their uses.
7. List safety equipment.
8. Identify hand tools used in forestry. (Assignment Sheet 1)
9. Identify power equipment used in forestry. (Assignment Sheet 2)
10. Design a tool kit. (Assignment Sheet 3)
11. Analyze accidents involving tools. (Assignment Sheet 4)

12. Demonstrate the ability to
    a. Use an ax properly. (Job Sheet 1)
    b. Use a shovel properly. (Job Sheet 2)
    c. Sharpen a double-bitted ax with a file. (Job Sheet 3)

PREPARATION

- Obtain materials to supplement unit.

  NOTE: See Suggested Resources.

- Review instructional outline for this unit. Modify time frames to suit class needs and plan activities for each class period.

- Study the specific objectives to determine those you will cover in your presentation. Decide also which objectives should be taught to which students.

- Determine scope and sequence of objectives that you add. Design and develop support materials, including evaluation techniques, for additional objectives.

- Determine how you will schedule time for students to demonstrate competence in the required procedures.

- Arrange for a tour of a logging operation and a sawmill where power equipment is in use.

- Invite a soil conservation specialist to describe how the soil survey is used, how the survey is made, and the information on the SPI sheet.

- Invite an equipment operator to describe operating and using equipment.

- Invite a chiropractor, physician or osteopath to discuss how to use the body correctly and avoid injuries when using tools.

- Invite an experienced logger to discuss using safety equipment on the job.

  NOTE: Supply guest speakers with the specific objectives and other appropriate sections of the unit.

- Watch for and videotape national logger competitions televised on ESPN or other networks, particularly in the fall. Students will be interested in ax, chainsaw, log rolling, cross-cut saw and other competitive events.

- Refer to Unit 14, *Identify Forest Fire Protection Practices*, for additional tools used in fire fighting.

DELIVERY

Objective 1

- Share with students your own experiences with tools and equipment and with safety procedures and accidents.
- Review terms with students.
- Ask students to share their experiences with using tools.
- Ask for examples of tools with beveled edges.

Objective 2

- Show examples of tools and demonstrate use and safety procedures.
- Have students complete Assignment Sheet 1.
- Have students learn and practice Job Sheet 1 and complete the practical test.
- Take students to the Soil Conservation Service or have a soil conservationist talk to the class about the soil survey and SPI sheets.
- Ask students to identify the section they live in and obtain SPI sheets for these areas.

Objective 3

- Demonstrate the correct way to carry shovels, axes, and picks.
- Discuss the potential hazards each rule is intended to counter.

Objective 4

- Invite a physician, chiropractor or osteopath to discuss injuries and how to prevent them.
- Demonstrate and allow students to practice correct use of the body with tools.
- Have students learn and practice Job Sheet 2 and complete the practical test.

Objective 5

- Discuss the importance of good maintenance.

- Have students look up the price of tools in a catalog and inventory your tool supply to stress the importance of proper maintenance.
- Have students learn and practice Job Sheet 3 and complete the practical test.

Objective 6

- Take students on a field trip to see power equipment in operation.
- Invite an equipment operator to discuss operation and safety and to describe the work performed by the equipment.
- Have students complete Assignment Sheet 2.

Objective 7

- Encourage students to complete Activity Sheet 1 to review the unit.
- Demonstrate the use of safety equipment.
- Invite an experienced logger to discuss using safety equipment on the job.
- Have students complete Assignment Sheets 3 and 4.

APPLICATION

Objective 8

- Use Assignment Sheet 1 to test students over tool recognition.

Objective 9

- Use Assignment Sheet 2 to test students over power equipment recognition.

Objective 10

- Use Assignment Sheet 3 to allow students to imagine a job situation and design a tool kit.

Objective 11

- Use Assignment Sheet 4 to allow students to analyze accidents involving tools.

Objective 12

- Use Job Sheet 1 to teach students how to use an ax properly.
- Use Job Sheet 2 to teach students how to use a shovel properly.
- Use Job Sheet 3 to teach students how to sharpen an ax blade with a file.

EVALUATION

Practical test

- Explain to students that they will be asked to demonstrate procedures on the job sheets to complete the practical test.
- Describe the rating scale used on the practical test.
- Give practical test.
- Reteach and retest as necessary.

Written test

- Explain to students that they will be asked to demonstrate on the written test actions listed in the specific objectives.
- Give written test.

  NOTE: The written test may be given in sections if desired.
- Evaluate students on assignment sheet activities if not previously done.
- Reteach and retest if necessary.
- Complete appropriate section of competency profiles.
- Review individual and group performance in order to evaluate teaching methods. Adjust scope, sequence, or instructional approaches for additional lessons as required.

SUGGESTED RESOURCES

Publications

- *County Soil Survey.* Available without charge from your county Soil Conservation Service.
- *Forestry Suppliers, Inc. Catalog.* Available from Forestry Suppliers, Inc. P.O. Box 8397, Jackson, MS 39284-8397, (800) 647-5368.

- *Ben Meadows Catalog*. Available from Ben Meadows Company, 3589 Broad St., P.O. Box 80549, Atlanta (Chamblee), GA 30366, (800) 241-6401.

Speakers

Oklahoma Natural Resources Speakers Bureau sponsored through Oklahoma State University, Division of Agriculture, Oklahoma Cooperative Extension Service - Forestry, Oklahoma Conservation Commission and the Oklahoma Forestry Association. Lists speakers on a variety of forestry-related topics. Speakers operate on a time-available basis. Request a listing of speakers, programs, slide presentations and videotapes from your local extension office or from:

Dr. Steve Anderson
Forestry Dept.
Oklahoma State University
239 Agricultural Hall
Stillwater, OK 74078
(405) 744-9431

Dave Marcouiller
Forestry Dept.
Oklahoma State University
242 Agricultural Hall
Stillwater, OK 74078
(405) 744-5444

Teachers from outside of Oklahoma should contact the Forestry Extension Office in their state.

Audiovisual Materials

- *Total Wood Use: A Quality Commitment*, 1/2" VHS, color, 15 min., ARD Productions, Inc., 1988. Available from ARD Productions, Inc., Hot Springs, Arkansas. Shows timber harvesting equipment used in Weyerhauser operations in Wright City, Oklahoma, and shows the processes involved in making timber.

  NOTE: This video is available to Oklahoma teachers on a free-loan basis. Oklahoma teachers may order this video from the Oklahoma Department of Vocational and Technical Education, Resource Center, ATTN: Instructional Media Specialist, 1500 W. Seventh Avenue, Stillwater, Oklahoma 74074.

UNIT REFERENCES

- Anderson, David A., and I. I. Holland, *Forests and Forestry*, Danville, Illinois, The Interstate Printers & Publishers, Inc., 1982.
- *Harvesting Forestry Products*, Texas A & M University, College Station, Texas, 1976.

- Simmons, Fred C., *Handbook for Eastern Timber Harvesting*, U.S. Department of Agriculture, Forest Service, Northeastern Area, State & Private Forestry, Broomall, Pennsylvania, 1979. Available from the U.S. Government Printing Office, Washington, D.C.
- Williams, Sandra Perky, *Introduction to Horticulture*, Curriculum and Instructional Materials Center, Oklahoma Department of Vocational and Technical Education, Stillwater, Oklahoma, 1989.

SOLUTION TO CROSSWORD PUZZLE

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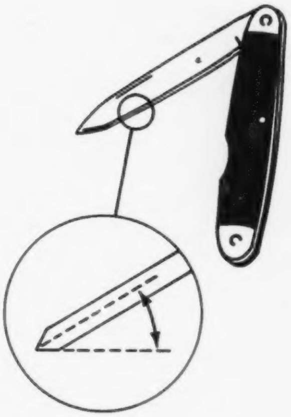
OBJECTIVE 1

Match terms associated with the basic tools of forestry to their correct definitions.

- **Beveled**—Edges are angled to create a sharp cutting surface



Beveled Edges

- **Bucking**—Sawing logs into short lengths
- **Burr**—Sharp particles left on edges after filing or sharpening
- **Choker**—A short length of wire rope or chain that forms a noose around the end of a piece of wood to be skidded
- **G.V.W.**—Gross vehicle weight
- **Grapple**—A tong-like device used to pick up logs for skidding and loading logs and wood
- **Head**—Working part of a hand tool attached to the handle, made of metal
- **Hydraulic**—Moved by the force or pressure of liquid
- **Log deck**—Place where logs are accumulated (also called a yard or landing)

- **Prune**—To cut dead or living parts from a plant in order to increase fruit or flower production; to improve the form or to remove dead or diseased parts

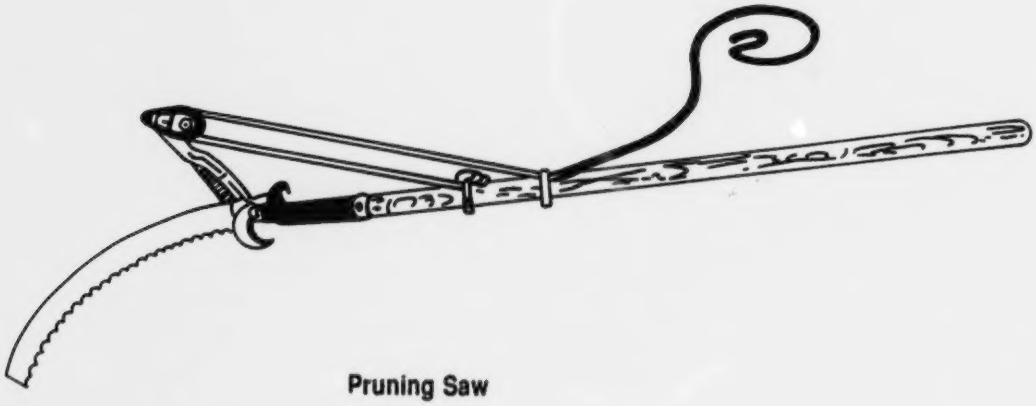
- **Skid**—To drag logs or tree lengths either wholly or partially on the ground

OBJECTIVE 2 **Match tools to their uses.**

Hand tools

- **Pruning saw**—Used to remove branches larger than 1 1/4" in diameter

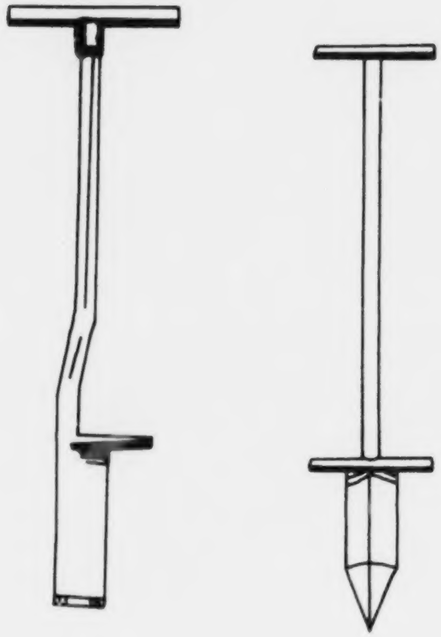
  NOTE: May have double-edge blades with small teeth on one edge and larger teeth on the other for use on smaller or larger branches. Pruning saws are available in curved, straight blade, and folding models.



Pruning Saw

- **Planting bar**—Cuts into soil for setting seedlings and fertilizer pellets

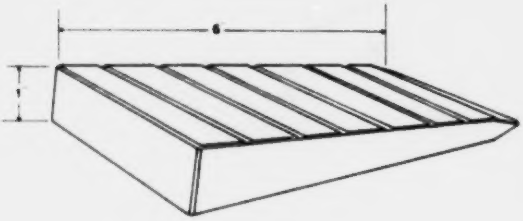
  NOTE: This tool is sometimes called a planting hoe.



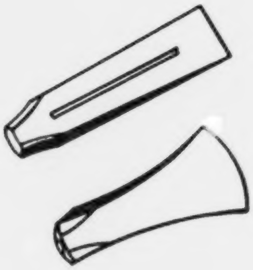
Planting Bars

- **Wedges**—Inserted into wood behind a chainsaw to keep saw blades from being pinched in a cut; used to start a tree falling in the right direction

  NOTE: Chainsaw wedges are made of plastic, wood, or soft metal that won't damage the blade. Splitting wedges are used for splitting firewood and are short sections of steel bars that can be pounded with a heavy maul.



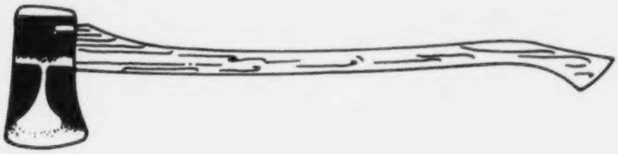
Wedge Used Behind A Chainsaw



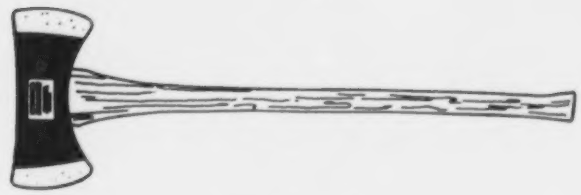
Splitting Wedge

- **Ax**—Used in logging for cutting small brush, for driving wedges, for chopping out a saw stuck in a cut; used in fire fighting for cutting limbs and small trees to remove potential fuel from a fire

  NOTE: Most professional woodcutters carry a single-bit ax in a belt holster. Fire fighters may use long-handled double-bit axes.



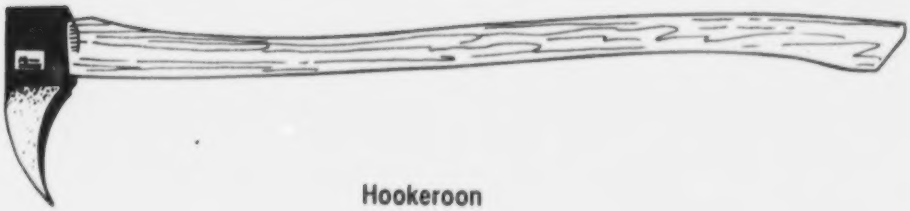
Single Bit Ax



Double Bit Ax

- **Hookeroon**—Used to move pulpwood logs into position on logging trucks

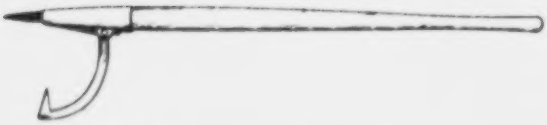
  NOTE: A worker drives the hook into the end of the log to make it lie straight on the truck bed.



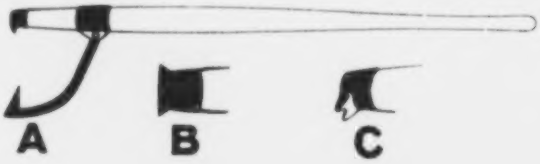
Hookeroon

- **Peavey and canthook**—Used for rolling logs

  NOTE: The peavey and canthook are stout wooden poles with a curved hook at the side. The peavey has a spike in the end of the stock; a canthook has no spike. The peavey is used to roll logs.



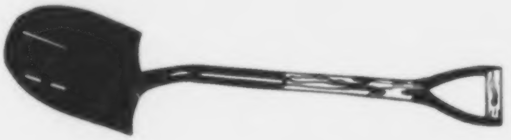
Peavey - Note The Spike



Canthook - No Spike

- **Shovel**—Used for digging and lifting loose sand and soil

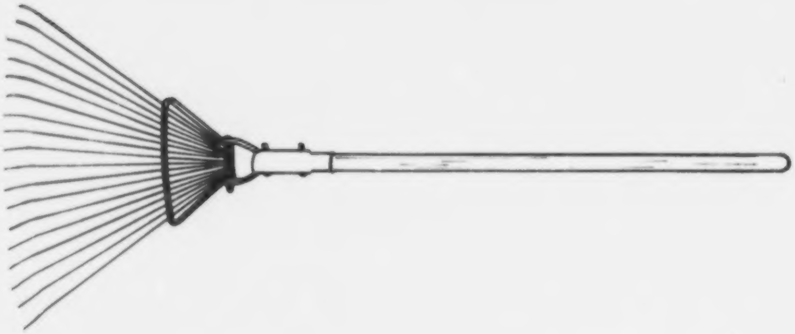
  NOTE: The round-nose or round-end shovel is the most common, all-purpose shovel. Other common shovels are the pointed-end shovel for digging in hard soils and the square shovel for moving gravel and sand.



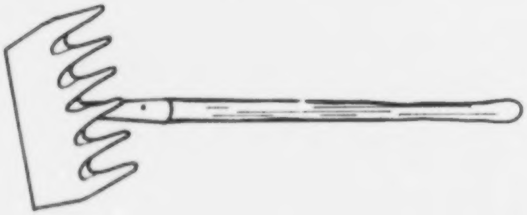
Round-Nose Shovel

- **Rakes**—Used to remove leaves and twigs to clear fire break

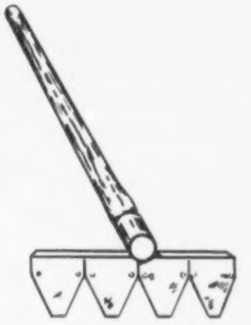
  NOTE: Rakes and swatters are the most commonly used tools in southern deciduous forests. Council rakes have steel cutting teeth. The McLeod is normally used with a Pulaski (see below) or a fire rake in rocky or bushy terrain.



Firebroom Rake For Clearing Light Litter



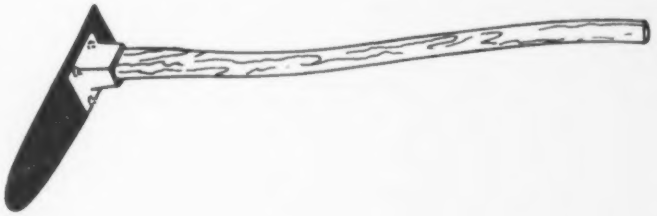
Mcleod Rake/hoe For Clearing Matted Leaves and Loose Debris



Council Rake For Digging; Cutting Grass, Small Brush Or Saplings; Rolling Burning Logs

- **Hoe**—Used to plant tree seedlings on slopes or in hilly terrain

  NOTE: Also called a hoedad. Heavy-duty hoes are used for fire fighting.



Hoe

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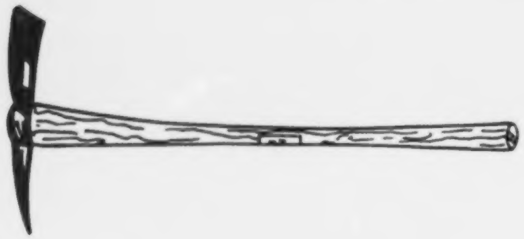
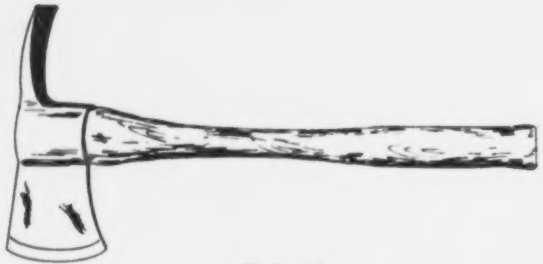
- **Pick**—Used for digging in hard surfaces

  NOTE: A Pulaski is a combination ax and pick used in cutting firelines.

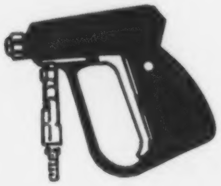


Pick



Pulaski

- **Spotgun applicator**—Used to spray herbicide; used with a backpack pressure spray tank



Spotgun Applicator

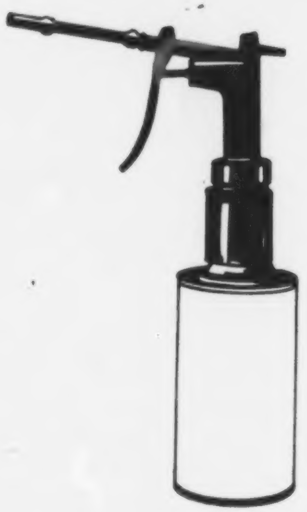
- **Plastic flagging**—Brightly colored tape for marking

  EXAMPLES: Marking boundaries, fire line, roads or trails, trees to be painted or marked for harvest, make survey stakes more visible, identify trees by writing a number on the flagging

  NOTE: Good foresters always remove their flagging after the job is finished to reduce litter in the woods.

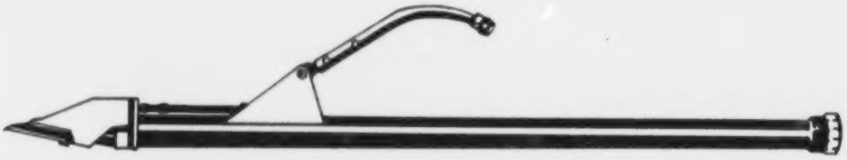
- **Tree-marking gun**—Sprays paint spot on trees to be cut or left uncut

  NOTE: Tree-marking guns and paint come in a variety of designs, including nozzles and triggers that attach to pressurized paint cans, to backpack pressure tanks, and to plastic or metal canisters.



Tree Marking Gun

- **Tree injector**—Places herbicides inside the bark



Tree Injector

Pocket tools

- **Compass**—Used to survey boundaries, identify map locations, locate specific sites, and find direction
- **Pocket calculator**—Used to figure acreage; estimate volume, weight, and value of timber; find slope, etc.
- **Folding knife**—Used for general-purpose cutting and prying

  EXAMPLES: Cut branches for stakes, cut rope, rip flagging tape, open cans

Folding Knife

Other tools

- *County Soil Survey*—A book used to identify soil types; contains aerial maps of the county and other useful information

  NOTE: Available from the USDA Soil Conservation Service in each county.

- **SPI sheets**—Describes soil type, characteristics, suitability for various land uses

  NOTE: SPI stands for Single Phase Interpretation. See Supplement 1.

- **ID key—Used to identify trees**

  EXAMPLES: ID cards, ID key in tree identification books, ID wedges

OBJECTIVE 3

State safety rules for using hand tools.

NOTE: Never underestimate the potential for accidental injury. Improper use of hand tools can cost you time away from work in addition to pain or discomfort.

- Always use a tool as it is designed to be used.
- Stay alert any time you use tools.

  NOTE: Negligence and carelessness cause most accidents. When accidents happen, many people say, "I wasn't thinking," or "I wasn't paying attention" or "Before I knew it . . ."

- Never use tools when you are tired or in a hurry.
- Keep tools in their proper places.
- Do not leave tools on the ground near work site.
- Put tools down with edges facing into the ground.

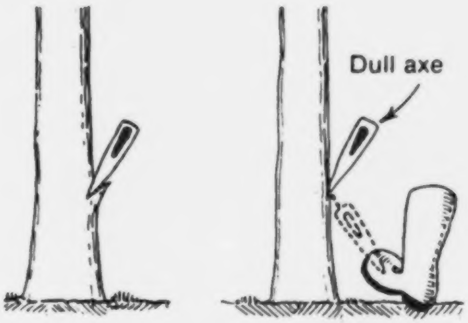
  NOTE: If a person steps on the head of a rake or hoe, the handle will hit the face and can cause broken facial bones and eye injuries.

- Inspect tools before use and often during use.

  NOTE: Always check tool heads for tightness and tighten loose heads before working. Check tools with screws or bolts often during use and tighten as needed.

- Keep cutting edges sharp.

  NOTE: Dull edges require more force to cut and added pressure can cause accidental slips and injuries.



A Dull Edge Is More Dangerous Than A Sharp One

Courtesy of USDA.

- Hold sharp or pointed tools so that the point is not in line with your body.

  EXAMPLE: Ax, hooks, pick or Pulaski, knife

- Carry shovels and other tools with the heads behind you.

- Carry and use long-handled tools so they won't hit others working nearby.

- Locate all underground utility lines and pipes before digging.

- Wear appropriate clothing for the job.

  EXAMPLES: Wear leather-soled shoes for digging, not tennis shoes; wear hard-toed shoes when working around logs; dress warmly for cold weather; wear a hat when working in the sun, etc. (See Unit 6 - Practice Forest Safety.)

OBJECTIVE 4 **Select from a list true statements about correct use of the body to avoid injuries.**

NOTE: Back injury and strained or sprained muscles are common in most physical work. Learn how to use your body and your tools correctly and you will stay strong, and be able to work more efficiently and with less stress.

- Never pick up a load that is too heavy.
- Use leverage rather than lifting or pushing whenever possible.
- Hold the tool close to your body rather than stretching or using a long reach.
- Use your legs to lift, not your back.
- Keep shoulders, hips and feet aligned; don't twist the back.
- Hold wrists straight and use the elbow for leverage, not the shoulder or wrist.

  NOTE: When the wrist is bent, the weight of an ax, hammer, or pick can sprain the muscles. It is difficult to hit straight-on unless the wrist is straight. Keep the shoulder level, wrist straight, and move the arm at the elbow.

- Let the weight of the tool carry it; keep elbows bent, pull in short strokes.

  NOTE: When using a hoe, pick or Pulaski, raise the tool and let it fall. If elbows are straight, they absorb the full shock of the impact.

- Keep your weight balanced.

  NOTE: Avoid leaning or reaching while using a tool; move closer to the object and stand firmly on both feet.

OBJECTIVE 5 **State procedures for maintaining hand tools.** (Job Sheet 3)

- Keep tools clean
- Keep tools free of rust

  NOTE: Remove rust with a scraper or steel wool and a rust remover. Dry thoroughly, oil, and store properly.

- Check tools often and tighten or replace screws, bolts, handles and heads as needed

- Sharpen or replace dull cutting edges
- Repair broken or damaged tools promptly
- Dispose of broken tools that cannot be repaired
- Keep moving parts oiled
- Oil wooden handles with linseed oil to prevent drying and splitting

OBJECTIVE 6

Match types of power equipment to their uses.
(Assignment Sheet 2)

NOTE: All power equipment is dangerous. When you are around heavy equipment wear a hard hat and be constantly alert for movement of machinery or logs. It only takes an instant to lose an eye or an arm or your life.

- **Chainsaw**—Used for felling timber, delimbing, and bucking logs

Courtesy of Oklahoma State University Agricultural Communications.

The gasoline-powered chainsaw is the most widely-used tool in logging operations, used for felling, limbing and bucking. Professional woodcutters prefer chainsaws with short bars rather than long bars. The short bars are easier to carry and handle, weigh less and cost less, and they reduce the risk of kickback when the tip of the bar touches other objects.

NOTE: The chainsaw replaced the ax and crosscut saw during World War II, and tripled the amount of wood an experienced woodcutter could produce in a day.

- **Feller-buncher**—Cuts trees and carries several at once for row thinning, clearcutting and heavy pulpwood cutting operations

Feller-Buncher

Cutting shears are mounted on a large hydraulic arm attached to a tractor or skidder. There are three types of shears: (1) a single blade that cuts against a fixed anvil, (2) two blades closing against each other like giant scissors, and (3) a spiraled router-type cutting blade. A cradle and clamp allow the machine to carry several trees upright after they've been cut and then lay them down for limbing, bucking, chipping, etc. Some models have limbing and topping attachments. A feller-buncher can cut 150 trees per hour.

- **Skidders**—Drag cut material such as logs, limbs, and brush out of the woods

  The material is carried with a grapple or tied to the skidder with chokers, then dragged in bundles to a landing where it will be processed or loaded onto logging trucks. Most skidders are four-wheel drive rubber-tired tractors with strong pulling power. Crawler tractors are also used, and provide better traction in mud and on slippery soils. Rubber-tired skidders are available in sizes ranging from a 2-ton "mini-skidder" with about 40 hp to huge 30-ton machines with powerful 300 hp engines.

Skidder

Several sizes of skidders may be used on the same operation. The skidder most commonly used is about 100 hp, weighs about 5 tons and is equipped with a rear-mounted winch or a hydraulic grapple to pick up logs. It can handle about 500 board feet of hardwood logs. Skidding distance is normally about 1/8 mile to 1/2 mile.

- **Loaders**—Used to lift logs from the ground to a log-hauling truck

  There are several types of loaders. Most use a hydraulic knuckleboom arm with a grapple to lift the load. It may be mounted directly on the hauling truck or mounted on a separate vehicle. (See front-end loaders)

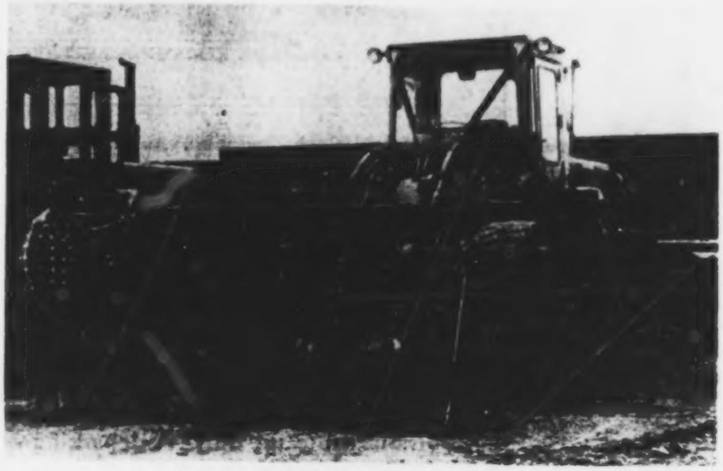
- **Knuckleboom loaders**—The overwhelming favorite in many logging operations because they can pick up logs from a landing or along the road and load them right onto the truck for transport. Their drawbacks are that the arm can't reach out very far to pick up the load and it can't lift heavy loads at the end of its reach.

Knuckleboom Loader

- **Front-end loader**—Used for a variety of jobs such as pushing, stacking and lifting logs, dozing and leveling yard areas

A front-end loader is a highly versatile piece of equipment, mounted on a wheeled tractor with hydraulic lift arms. It can be fitted with attachments such as log grapples, dozer blades, shovels, and loading buckets. Loaders are available in a variety of sizes from miniloaders to enormous monsters.

Front-end loaders require a large area of firm ground to maneuver and can bog down in wet landings. As a result, they are more frequently used in log decks and mill yards than on landings in the woods.



Front-End Loader

- **Stacker—Unloads logging trucks**

Stacker

- **Chippers—Break up pulpwood logs and limbs for sale to paper mills and wood products manufacturers**

  Small models are used in cutting areas and large models are used in landings and yards. A large chipper can lift whole trees, feed them under a turning drum that collapses the limbs and carries the whole log into the chipping blades. The chips are blown into an enclosed trailer or van for transport to the mill. A debarking machine can be attached to the chipper.

Chipper

- **Delimber**—Removes limbs and branches from whole trees

  NOTE: Delimbing with a chainsaw is a dangerous operation, accounting for many personal injuries. Mechanical delimbers are faster and safer than delimbing with chainsaws.

Delimber

- **Dozers**—Used to rough-cut roads and drainages, level ground, push over trees, pull stumps, move slash and rubble, and haul logs

  The dozer, or bulldozer, is a steel blade mounted across the front of a standard crawler tractor. The blade can be raised and lowered, pitched forward and back, and on some models, called angle dozers, can angle right and left. Blades are available for cutting straight, cutting angles, and snowplowing.

Dozer

441

- **Grader**—Used to finish-cut and level roads

  A cutting blade that slices the surface is attached to a curved steel moldboard that rolls and mixes the dirt as it is moved. The grader blade can be raised, lowered, rotated, pitched forward and backward, tilted, shifted to either side, and angled vertically and horizontally.

  The variety and amount of movement allows the grader to cut various depths, angles, and slopes, and to place dirt in specific places.

Grader

- **Power Plants**—Run lights and equipment for mechanical harvesting

  NOTE: In peak seasons harvesting operations will run around the clock with power plants providing lights for night work.

- **All-Terrain Vehicle** (ATV)—Provides access to remote areas, carrying limited amount of personnel and equipment; used to patrol fire lines during a controlled burn; and to seed logging roads

ATV

NOTE: After logging operations are finished, grass is planted on the roads to prevent erosion and help the area recover.

443

- **Logging trucks**—Haul products from logging operations to market

  Trucks range in size from 3-ton pickups with flat, bobtail beds to 50-ton GVW diesel cabs on three powered axles and used to haul tree-length logs at highway speeds. Logging trucks and truck tractors that pull collapsible pole trailers and flatbed trailers are designed for highway use or off-highway use. Side racks are added to flatbed trailers for hauling logs or cut timber.

Logging Truck

- **Lowboys**—Haul equipment

  The lowboy is a 30-48 ft flatbed trailer towed by a truck tractor. It is usually equipped with a winch at the front of the trailer and ramps at the back to get dozers, skidders and other equipment onto the trailer.

Lowboy

- **Dump trucks**—Haul dirt and gravel for building logging roads

Dump Truck

- **Fuel trucks**—Carry and hold fuel for operating heavy equipment, power plants and trucks

Fuel Truck

OBJECTIVE 7

List safety equipment. (Assignment Sheets 3 and 4, Activity Sheet 1)

NOTE: Safety equipment protects you from injury. There is nothing brave or "cool" about people who don't wear safety gear. Suppose Bob gets a wood chip through the eye or that a falling branch hits Sue on her bare head because it's uncool or too much trouble to wear safety glasses and a hard hat. They suffer injuries that may take a long, painful time to heal; and Bob could lose his eye. They lose time from work, the company loses valuable members of the production team. Their coworkers have to leave the job site to take care of Bob and Sue, and others have to carry an extra work load. When there is an injury because of negligence, everyone loses.

- Hard hat
- Safety glasses
- Gloves

  NOTE: Gloves are not worn around machinery with moving parts that could catch the glove and injure a hand.

- Hard-toed shoes

- Ear protection

  NOTE: There are many types of hearing protection available, from foam ear plugs to hi-tech mufflers built into a hard hat.

- Chaps

  NOTE: Chaps can be made of different materials for protection against brush, rain, snakebite, and chainsaws. Metal and hard plastic shields are used to protect knees, shins, ankles and feet.

- First-aid kit

  NOTE: Kits should contain sterile dressings, prepared splints, and other emergency equipment ready for use before an accident occurs.

  EXAMPLES: Antiseptic to kill germs and bacteria
  Adhesive bandages for various-sized wounds
  Gauze pads, various sizes
  Gauze roller bandages
  Triangular bandages for large wounds and slings
  Tourniquet to control massive bleeding
  Scissors
  Tweezers
  Elastic bandages for sprains
  Pain relievers
  Snake-bite kit

SINGLE PHASE INTERPRETATION SHEETS (SPI SHEETS)

SPI sheets have been prepared for each kind of soil that has been mapped in the county. Each sheet has a brief description of each kind of soil, its properties, and predictions of its behavior for various uses.

At the top of each SPI sheet is the map symbol and the name of the soil for each area on the soil map which has that symbol in it. Below this is a brief paragraph that describes the nature and properties of the soil and tells where the soil is in the landscape.

The table, "Estimated Soil Properties," at the top of the sheet, gives estimates of properties, characteristics, and conditions which influence the behavior of the soil when used for different purposes.

The soil is also rated for selected uses expected to be important or potentially important to the user. Ratings are given in terms of *limitations* and *suitability*. Up to three of the most restrictive features are listed.

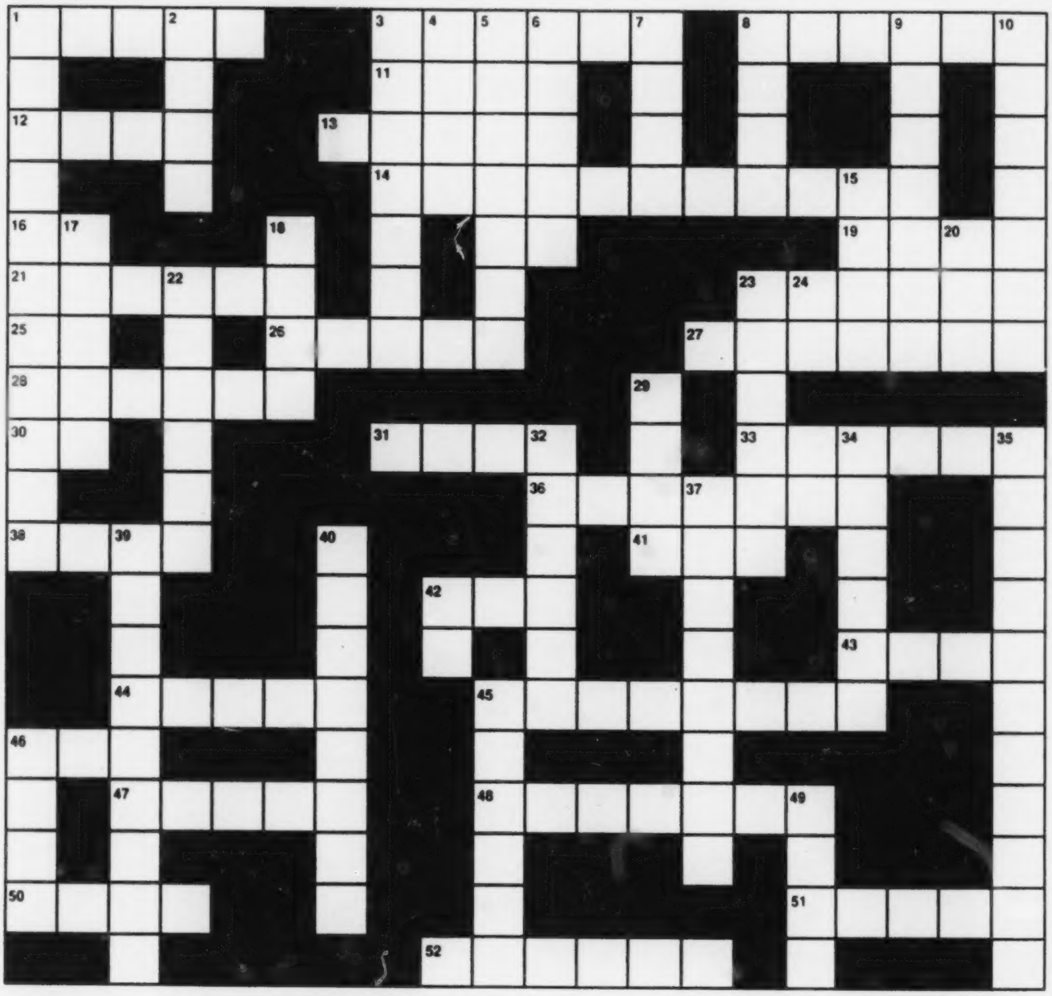
TOOLS, EQUIPMENT AND SAFETY CROSSWORD PUZZLE

ACROSS

1. Stay ________ any time you use tools.
3. Tools used to keep a chain saw blade from being pinched in a cut.
8. Oil wood handles to keep them from splitting and ________.
11. Opposite of under.
12. Tool used for digging in hard surfaces.
13. Place where rodeos and sports events are held.
14. Type of loader.
16. Exclamation.
19. A good forester ________ the moving parts of tools.
21. Log-rolling tool with a spike.
23. Crossword _______.
25. Resident advisor (abbr.)
26. Keep cutting _______ of tools sharp.
27. Plants seeds a second time.
28. Word for people who don't practice safety with tools and equipment.
30. As good ____ gold.
31. Mufflers and foam plugs protect these.
33. Store tools in their proper ________.
36. When using tools with long ______, take care not to hit others working nearby.
38. Sound effect that occurs in the mountains and in music.
41. Little tool used in golf.
42. Vehicle for getting to remote areas.
43. Orderly.
44. Tool used for general-purpose cutting, such as whittling and opening cans.
45. Brightly colored tape for marking.
46. Tool used to plant seedlings on slopes or in hilly terrain.
47. Use the _______ tool for the job.
48. Equipment that moves logs from the ground to a truck.
50. To let go of.
51. Where forester work.
52. Equipment used to finish-cut and level roads.

DOWN

1. Use the ________ tools for the job.
2. Tool used to remove leaves and twigs to clear a fire break.
3. Doing your job.
4. The same on both sides.
5. Takes clothes off of a person or leaves off of trees.
6. Hymn, *Amazing* _______.
7. *County* ________ *Survey Book*.
8. Word used to describe a person who doesn't use safety gear.
9. To list separately.
10. Safety ______ protect eyes from flying particles.
15. Seep up from the ground.
17. Working parts of hand tools, made of metal.
18. Safety glasses protect these.
20. A lawyer's degree.
22. Magic practiced in the Caribbean Islands.
23. When using long-handled tools, be careful not to hit other _______.
24. You and me.
29. ________ hook — log-rolling tool with no spike.
32. Tool used for digging and lifting loose sand or soil.
34. Requesting.
35. The first rule of safety.
37. Use tools as they were ___ __ to be used.
39. Tool used to align logs on a truck bed.
40. Tool used to place herbicides inside tree bark.
42. Tool used for cutting branches and brush, driving wedges and freeing a pinched saw blade.
45. _____________ buncher.
46. Type of hat worn for safety.
49. Tools used for felling timber, delimbing, and bucking logs.



ASSIGNMENT SHEET 1

IDENTIFY AND USE BASIC TOOLS OF FORESTRY

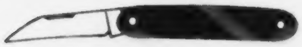
VII

NAME ______________________________ SCORE ________

OBJECTIVE 8 **Identify hand tools used in forestry.**

INTRODUCTION Knowing the tools of the trade is one of the first steps in learning a field. These tools are primarily the basic tools of timber harvesting, and are by no means all the tools used. Remember that there are many career fields in forestry, each with its own tools and resources. The tools in this assignment sheet are commonly found in forestry competitions.

DIRECTIONS Write the name of the tool under its picture.



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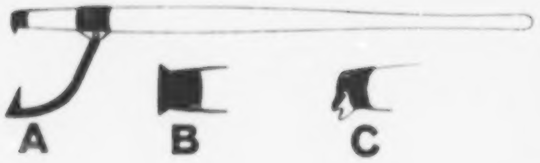

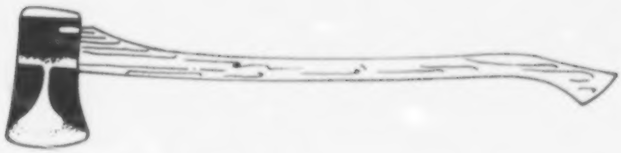

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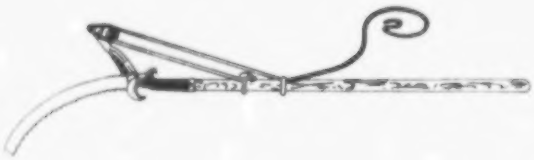

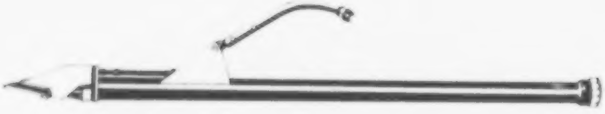

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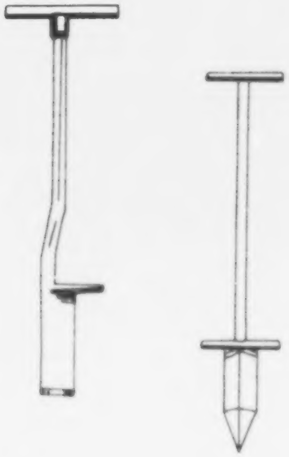
6. ______________________________



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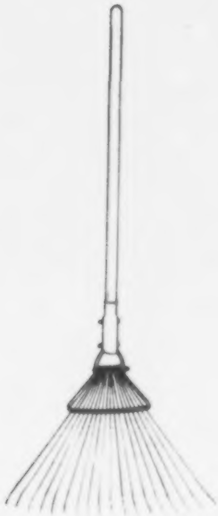

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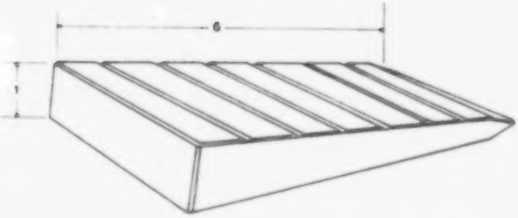

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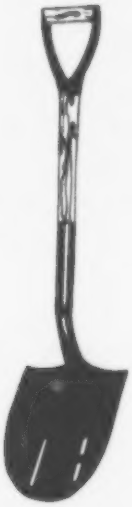

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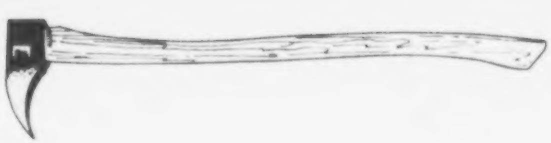

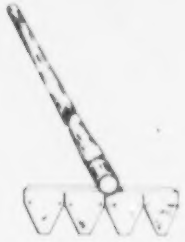

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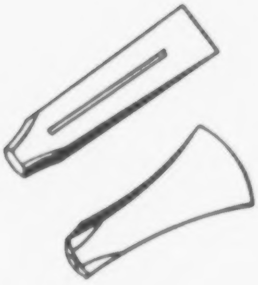
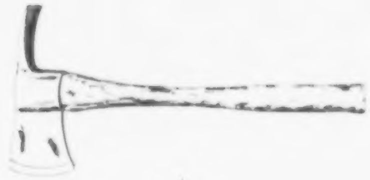
12. ______________________





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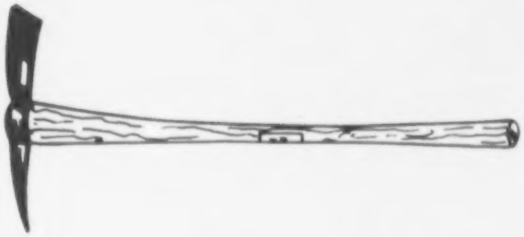
14. ______________________



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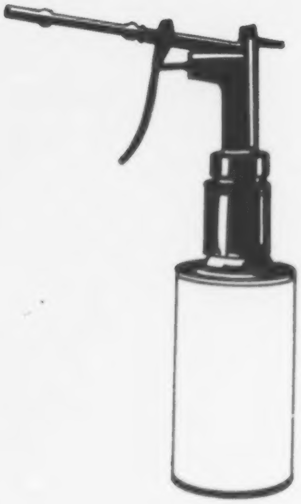

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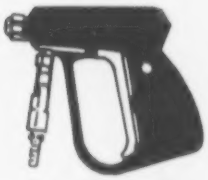

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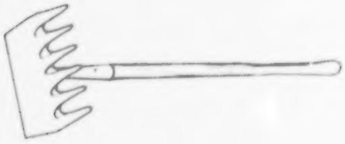


18. ____________________

ASSIGNMENT SHEET 2

IDENTIFY AND USE BASIC TOOLS OF FORESTRY

VII

NAME ________________________ SCORE ______

OBJECTIVE 9 **Identify power equipment used in forestry.**

INTRODUCTION Logging and forest product industries use interesting equipment. Powerful, efficient, requiring skill to operate, this equipment can do an amazing range of work for forest industries.

DIRECTIONS Write the name of the equipment under the picture.

1. ______________________________

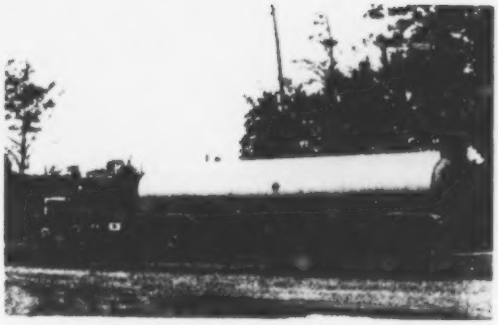
456

2. ______________________________

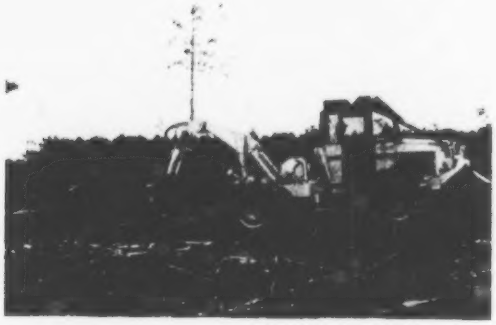
3. ______________________________

4. ________________________________

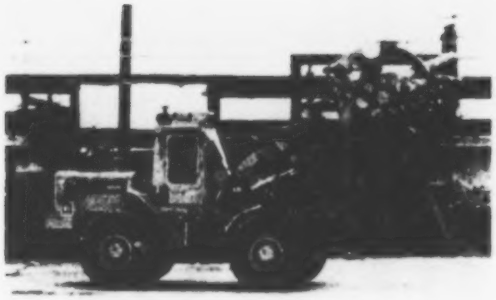
5. ________________________________



6. ____



7. ____



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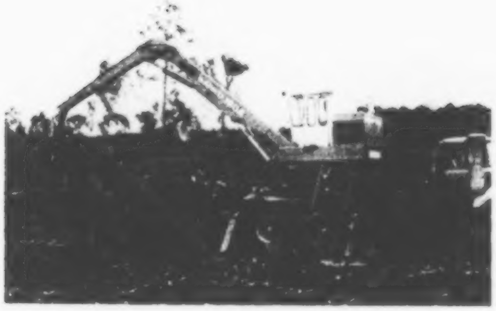
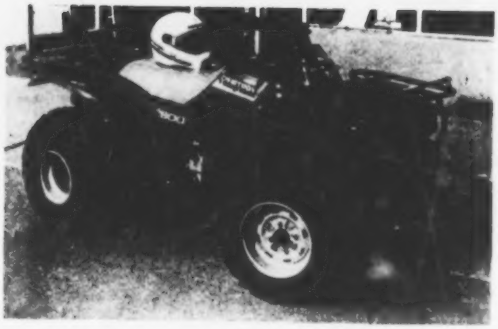


9. ______________________________

460



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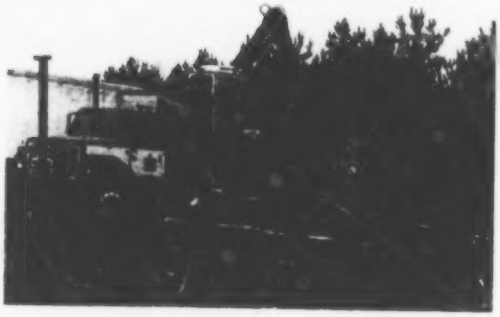
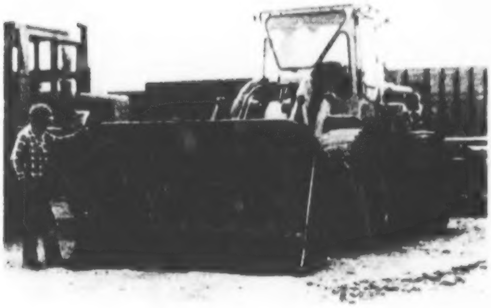


11. ______________________________

461

12. ______________________________



13. ______________________________

14. ____

15. ____

ASSIGNMENT SHEET 3 — IDENTIFY AND USE BASIC TOOLS OF FORESTRY — VII

NAME ______________________________ SCORE _______

OBJECTIVE 10 **Design a tool kit.**

INTRODUCTION

All field foresters have tools and safety equipment that they keep in their trucks and carry with them at all times. Naturally, a logger carries different tools than a timber cruiser who estimates volume and value of timber. But knowing what you know now about career opportunities (Unit 2), safety (Unit 6) and tools, you can put yourself in the place of a field forester and choose the personal and truck tools you would carry on a day-to-day basis.

Refer to Units 2 and 6 to refresh your memory. Use a forestry supplies catalog to help you make your decisions, especially for packing your safety gear.

DIRECTIONS

Design a tool kit for yourself as a field forester. Select a career and list the tools you would carry with you in your truck and on your person to perform that job. Use your imagination, your common sense and what you have learned in other units and through your own experience. Remember to consider safety and outdoor conditions.

Career field ______________________________

Tools carried in the truck

____

____

____

____

Tools carried with you into the field

____

____

____

____

ASSIGNMENT SHEET 4

IDENTIFY AND USE BASIC TOOLS OF FORESTRY

VII

NAME ______________________________ SCORE _______

OBJECTIVE 11 **Analyze accidents involving tools.**

INTRODUCTION

People make mistakes with tools, even when they know the right ways to use them. When you understand why safety rules are used, it's easier to remember to follow them.

1. Always use a tool as it is designed to be used.
2. Stay alert any time you use tools.
3. Never use tools when you are tired or in a hurry.
4. Keep tools in their proper places.
5. Do not leave tools on the ground near work site.
6. Put tools down with edges facing into the ground.
7. Inspect tools before use and often during use.
8. Keep cutting edges sharp.
9. Hold sharp or pointed tools so that the point is not in line with your body.
10. Carry shovels and other tools with the heads behind you.
11. Carry and use long-handled tools so they won't hit others working nearby.
12. Locate all underground utility lines and pipes before digging.
13. Wear appropriate clothing for the job.

DIRECTIONS

Read the following descriptions of accidents. Write in the numbers of the rule or rules that were broken and tell how the accident could have been prevented.

1. Alex, a high school summer employee at the logging camp, had been using an ax all afternoon to clear saplings away from a logging area. The ax hit the bark but instead of driving into the tree, it bounced off and hit the side of Alex's knee, slicing his knee open and cracking his kneecap. He spent the rest of the summer at home.

   Rule(s) broken ________

   How could the accident have been prevented? ____________

   ____

   ____

2. Maria and Bob worked on the fire break crew, using shovels and hoes to clear out twigs, leaves, and grass so the fire wouldn't have fuel to burn. Bob thought he could make better time with the hoe than the shovel, so he switched tools, leaving the shovel on the ground. Maria took a short break to back up and check the advancing fire. She backed onto the shovel. The handle swung up and hit her in the head. She fell forward, cutting her face on the corner of her McCleod rake/hoe. She had to lay off work for two hours to get her face treated and wait while the medic checked her for a concussion. Jerry, who had already worked 10 hours that day, took Maria's place on the fire line.

   Rule(s) broken ________

   How could the accident have been prevented? ____________

   ____

   ____

3. Jack took a night job as a school custodian to help pay the bills. He was tired, but drank plenty of coffee and ate several candy bars to keep his energy up. Today his chainsaw slipped and cut his thigh clear to the bone. His family had to take care of him for over three months.

   Rule(s) broken ________

   How could the accident have been prevented? ____________

   ____

   ____

4. Janice was cutting dead branches with a pruning saw. Max had asked her for a date tonight and she wanted to get a good suntan, so she took off her hard hat and safety glasses. She was thinking about what to wear for Max when the branch snapped. The date with Max never happened after the doctor shaved her hair to sew up her scalp.

   Rule(s) broken ________

   How could the accident have been prevented?________________

   ____

   ____

5. The first thing this morning, Carl drove a wedge behind a saw blade and the ax head flew off. Thankfully no one was standing in the way of the flying blade, but Carl's hand and arm hit the log and saw, cutting his hand and pulling a muscle in his arm. He missed four days of work waiting for his arm to heal.

   Rule(s) broken ________

   How could the accident have been prevented?________________

   ____

   ____

6. Robert was whittling a branch into a point to use as a stake when the knife slipped and he stabbed himself in the stomach. He got a tetanus booster and returned to work the next day.

   Rule(s) broken ________

   How could the accident have been prevented?________________

   ____

   ____

ASSIGNMENT ANSWERS

IDENTIFY AND USE BASIC TOOLS OF FORESTRY

VII

ASSIGNMENT SHEET 1

1. Peavey
2. Folding knife
3. Canthook
4. Ax
5. Pruning saw
6. Tree injector
7. Planting bars
8. Firebroom rake
9. Wedge
10. Shovel
11. Hookeroon
12. Council rake
13. Splitting wedge
14. Pulaski
15. Pick
16. Tree marking gun
17. Spot gun applicator
18. McLeod rake/hoe

ASSIGNMENT SHEET 2

1. Grader
2. Dump truck
3. Feller buncher
4. Dozer
5. Delimber
6. Fuel truck
7. Skidder
8. Stacker
9. Knuckleboom loader
10. ATV
11. Chipper
12. Lowboy
13. Front-end loader
14. Chainsaw
15. Logging truck

ASSIGNMENT SHEET 3

All answers should include:

- First-aid kit (may be in either category)
- Truck tools: shovel, pick or Pulaski, fire rake, water
- Personal tools: folding knife, compass, maps, drinking water
- Check that tools are appropriate to the career selected
- Check for safety equipment such as a hard hat, safety glasses, chaps, gloves, ear protection, first-aid kit
- Suggest tools they are not yet familiar with, such as note pad and pencil

ASSIGNMENT SHEET 4

1. Rules 7 and 8; student might include 3

   Sharpening the ax, checking it during the day.

2. Rules 6 and 10

   Bob should have taken the shovel away from the work site. At least he should have laid it down with the blade toward the ground. Maria should have carried the hoe with the head behind her.

3. Rule 3

   Jack should not have operated the chainsaw when he was tired. He shouldn't have taken a second job when his daytime work involved hard physical labor and power tools.

4. Rules 2 and 13

   Janice should have kept her mind on her work and worn her safety gear.

5. Rule 7

   Carl should have checked the head before he used the ax.

6. Rule 9

   Robert should have pointed the knife away from himself while cutting.

JOB SHEET 1

IDENTIFY AND USE BASIC TOOLS OF FORESTRY

VII

OBJECTIVE 12a

Use an ax properly.

TOOLS AND MATERIALS

- Ax
- Brushy area
- Gloves
- Safety glasses
- Hard hat

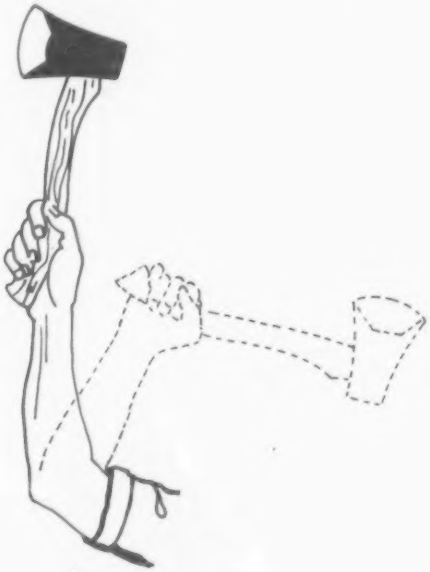
PROCEDURE

NOTE: Foresters use axes to clear the working area for logging operations. Once the direction of fall is decided for a tree, the cutter (1) clears the space around the tree so no snagging can occur with the chainsaw, clothing, or footing (2) clears a getaway path. The end of the chainsaw can catch on or can carry small pieces of brush or low-hanging limbs into the cut, causing a dangerous kickback or a jam.

1. Check condition of ax:
    a. Handle should be free of splinters, splits, and cracks.
    b. Head should be firmly fixed to handle.
    c. Blade should be sharp with no knicks or burrs.
2. Carry ax in a holster on belt or with your hand just below the head and the blade pointing down.
3. Walk to cutting area.
4. Put on gloves, remove ax from holster.
5. Hold a small hand-ax at the end of the handle; hold a longer ax in the narrow middle of the handle at the point of balance.

    NOTE: The point of balance is where the ax will lie even in your hand, neither end higher than the other.

6. Chop with the force moving from the elbow through the straight wrist to the ax head. Don't lift your whole arm.



Proper Arm Motion

Used with permission of the Boy Scouts of America.

7. **Cut small brush:**

   a. Bend at the knees to get close to the branch.

   b. Pull on the stem with one hand.

   c. Slice it with the ax, cutting away from your feet.

   CAUTION: Don't drive the ax into the dirt. It will dull the blade and you will have to spend additional time sharpening it.

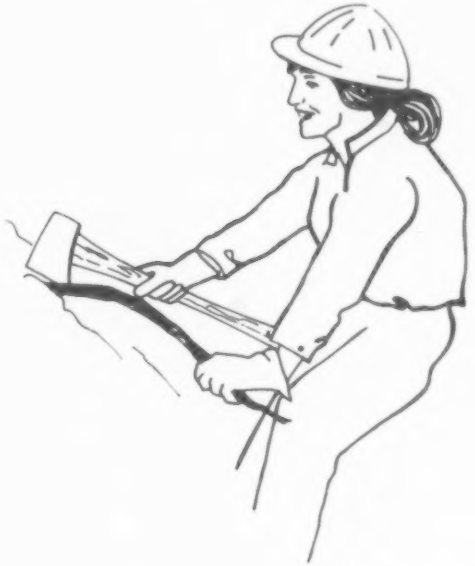
8. **Cut a sapling:**

   a. Move close to the sapling and bend at the knees, or place knee on the ground.

   b. Bend the sapling to the ground with the free hand.

   c. Make a single chop on the strained fiber at the base, angling the ax slightly toward the tip.

CAUTION: Don't drive the ax into the dirt. Cut at an angle.



Cutting A Sapling

d. Bend the stem the other direction and repeat the cut in Step c, cutting the sapling free.

9. **Cut small branches between ground and shoulder height.**

   a. Put on safety glasses and hard hat.

   b. Place your body so that you can grasp the outside end of the branch with your free hand.

   c. Take a position close to the joint of the tree and the trunk.

   d. Bend at the knees directly in front of the cut if the branch is low; be sure your weight is evenly balanced before you cut.

   e. Grasp the branch with your free hand.

   NOTE: The hand should be even with your shoulder, or no more than six inches to the outside, to insure that you have good leverage.

f. Chop away from you, at an angle.

CAUTION: Do not chop downward from the top to the bottom of the branch. If you miss or if the ax rebounds, it will come back toward your body.

g. Repeat the chopping until the branch is ready to fall.

h. Guide the fall away from you with your free hand and step back.

10. **Cut small branches over your head.**

    a. Put on safety glasses and hard hat.

    b. Take the same position as in Step 7, grasping the branch with your free hand.

    c. Stand angled slightly away from the joint of the branch and the tree.

    d. Chop at an angle toward the tree, pushing slightly on the branch with your free hand.

    e. Repeat the chopping until the branch is ready to fall.

    f. Guide the fall away from you with your free hand and step back.

11. Have your instructor check your work.

12. Put the ax in the holster or return it to the proper storage place.

JOB SHEET 2 — IDENTIFY AND USE BASIC TOOLS OF FORESTRY — VII

OBJECTIVE 12b

Use a shovel properly.

INTRODUCTION

Back injuries from digging are caused by twisting the body instead of turning, from lifting a load that's too heavy, and from lifting with the back instead of the legs. Even though you may have used a shovel many times, this job sheet requires that you learn to use it correctly and safely.

TOOLS AND MATERIALS

- Round-nose shovel
- Gloves
- Hard-soled shoes
- Pick, if ground is hard
- Tape measure
- Stakes marked at 8 in
- Unmarked stakes and/or flagging

PROCEDURE

Dig a hole 2 feet in diameter and 8 inches deep.

1. Determine location and mark area of hole.
2. Check shovel and handle for broken or weak points.
3. Put on gloves.
4. Place the shovel at about an 80° angle to the ground.
5. Press shovel into the soil with the right or left foot.

   NOTE: If the soil is too compact, loosen it with a pick.
6. Bend the knees and scoot the forward hand toward the head of the shovel.
7. Tilt the shovel back.
8. Place the rear hand so the shovel is balanced and neither arm is holding all or most of the weight.

9. Straighten the legs and lift the shovel up.

   WARNING: DO NOT LIFT WITH YOUR BACK MUSCLES.

10. Turn the *whole body* away from the hole, feet and shoulders facing the same way.

    NOTE: Turn far enough away from the hole that the dirt won't fall back into it as you make the hole wider.

    WARNING: DO NOT TWIST AT THE KNEES, HIPS, WAIST, OR SHOULDERS

11. Rotate the handle with your wrists so the dirt falls from the shovel.

12. Continue until hole is 2 ft around and 8 in deep.

Spread dirt with a shovel

NOTE: You will be filling up the hole you have just dug. The action of digging loose dirt and spreading or throwing it is used in building fire breaks and leveling small areas.

1. Take a position between the dirt and the spread area.

   NOTE: In this case the dirt is piled around the hole and the spread area is the hole. On a fire line, the dirt would be naturally loose or loosened with a pick or Pulaski and the spread area would be toward the fire.

2. Grasp the shovel with both hands, one hand forward on the handle.

3. Step toward the dirt with the same foot forward as the forward hand on the shovel.

   EXAMPLE: If the right hand is forward, step toward the dirt pile with the right foot.

   NOTE: This procedure helps prevent sprains and wrenched or dislocated joints.

4. Bend the knees slightly and scoop up a shovelful of dirt about knee-to-hip high.

   NOTE: Don't bend at the back.

5. Swing around, using the foot nearest the dirt pile as a pivot, and placing the other foot near the spread area.

   NOTE: Use an even swing keeping the hips, shoulders, and arms lined up and keeping the shovel about knee-to-hip high.

   WARNING: DO NOT TWIST AT THE KNEES, HIPS, WAIST, OR SHOULDERS.

6. Tilt the shovel to keep the dirt in front of it for an even spread.

7. Use a *short* thrust forward and up to throw the dirt, keeping arms slightly bent at all times.

   NOTE: You can throw sideways or over your shoulder *if* you keep your shoulder and hips aligned and use just your arms to throw. The back should not be twisted.

8. Continue throwing dirt until the hole is filled.

9. Tamp and level soil by walking on it and fill level to the ground.

   NOTE: There may not be enough dirt to fill the hole. You may have to move dirt from another place to make the area level.

10. Spread any remaining dirt evenly.

11. Have your instructor check your work.

12. Remove soil, mud, or other foreign matter from the shovel by scraping or washing with water or both.

13. Store the shovel in a dry, safe place.

JOB
SHEET 3

IDENTIFY AND USE BASIC TOOLS OF FORESTRY

VII

OBJECTIVE 12c

Sharpen a double-bitted ax with a file.

TOOLS AND MATERIALS

- Double-bitted ax
- 10-inch file with handle

  NOTE: Smaller files can place the hands too close to the blade and cause injury.

- Stump
- Gloves (leather preferred)

  CAUTION: Pay close attention when filing the ax. It's easy to get cut.

PROCEDURE

1. Drive one edge of the ax into the stump so it stands straight up.
2. Stand to one side of the ax, with both feet on the same side of the handle.
3. Hold file with one hand on the handle and fingers safely curved away from the ax blade.
4. Tap the file on the stump occasionally to knock metal filings out of the file teeth.
5. File across the cutting edge at a slight angle to remove nicks.

   NOTE: When the blade hits rock, the metal will dent or nick and get harder because it's compacted.

6. Apply light pressure with the forefingers and keep other fingers curled away from the blade.
7. File in one direction only.

   NOTE: Don't drag the file backward. Pick it up and make the next stroke in the same direction and at the same angle as the previous stroke.

8. Continue filing until the edge is smooth.
9. Hold the file at a slight angle to sharpen the edge.

10. Work from the top of the blade toward the stump.

    NOTE: Working from the top to the bottom prevents the formation of burrs at the edge.

11. File in one direction only.

    NOTE: Don't drag the file backward. Pick it up and make the next stroke in the same direction and at the same angle as the previous stroke.

12. Keep the original bevel.
13. Continue until the edge is smooth and correctly beveled for the length of the blade.
14. Walk to the other side and repeat the procedure.
15. When finished, remove ax from stump, turn and set the sharpened bit into the stump.
16. Repeat procedures to sharpen the other bit.
17. Have your instructor check your work.
18. Put away tools and materials and clean the work area.

10. Work from the top of the blade toward the stump.

    NOTE: Working from the top to the bottom prevents the formation of burrs at the edge.

11. File in one direction only.

    NOTE: Don't drag the file backward. Pick it up and make the next stroke in the same direction and at the same angle as the previous stroke.

12. Keep the original bevel.
13. Continue until the edge is smooth and correctly beveled for the length of the blade.
14. Walk to the other side and repeat the procedure.
15. When finished, remove ax from stump, turn and set the sharpened bit into the stump.
16. Repeat procedures to sharpen the other bit.
17. Have your instructor check your work.
18. Put away tools and materials and clean the work area.

JOB SHEET 1

Use an ax properly.

Student's name ______________________________ Date ___________

Evaluator's name ____________________________ Attempt no. _____

Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

Evaluator note: Write a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.

The student:	YES	NO
1. Checked condition of ax:		
a. Handle free of splinters, splits, and cracks.	_____	_____
b. Head firmly affixed to handle.	_____	_____
c. Blade sharp with no knicks or burrs.	_____	_____
2. Carried ax in holster on belt or with hand just below the head and the blade pointing down.	_____	_____
3. Walked to cutting area.	_____	_____
4. Put on gloves, removed ax from holster.	_____	_____
5. Held a small hand-ax at the end of the handle; held a longer ax in the narrow middle of the handle at the point of balance.	_____	_____
6. Chopped with the force moving from the elbow through the straight wrist to the ax head. Didn't lift the whole arm.	_____	_____
7. **Cut small brush:**		
a. Bent at the knees to get close to the branch.	_____	_____
b. Pulled on the stem with one hand.	_____	_____
c. Sliced it with the ax, cutting away from feet.	_____	_____

The student:	YES	NO
8. **Cut a sapling:**		
a. Moved close to the sapling and bent at the knees, or placed knee on the ground.	______	______
b. Bent the sapling to the ground with the free hand.	______	______
c. Made a single chop on the strained fiber at the base, angling the ax slightly toward the tip.	______	______
d. Bent the stem the other direction and repeated the cut in Step c, cutting the sapling free.	______	______
9. **Cut small branches between ground and shoulder height.**		
a. Put on safety glasses and hard hat.	______	______
b. Placed body so that he or she could grasp the outside end of the branch with the free hand.	______	______
c. Took a position close to the joint of the tree and the trunk.	______	______
d. Bent at the knees directly in front of the cut if the branch is low; weight was evenly balanced before cutting.	______	______
e. Grasped the branch with the free hand.	______	______
f. Chopped away from the body, at an angle.	______	______
g. Repeated the chopping until the branch was ready to fall.	______	______
h. Guided the fall away from body with the free hand and stepped back.	______	______
10. **Cut small branches over the head.**		
a. Put on the hard hat and safety glasses.	______	______
b. Took the same position as in Step 7, grasping the branch with the free hand.	______	______
c. Stood angled slightly away from the joint of the branch and the tree.	______	______
d. Chopped at an angle toward the tree, pushing slightly on the branch with the free hand.	______	______
e. Repeated the chopping until the branch was ready to fall.	______	______
f. Guided the fall away from the body with the free hand and stepped back.	______	______

The student:	YES	NO
11. Put the ax in the holster or returned it to the proper storage place.	____	____
12. Used proper tools correctly.	____	____
13. Performed steps in a timely manner.	____	____
14. Practiced safety rules throughout procedure.	____	____
15. Provided satisfactory responses to questions asked.	____	____
16. Put away tools and cleaned work area.	____	____

EVALUATOR'S COMMENTS

____

____

____

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See performance evaluation key). A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:				
Cut small wisps of brush	4 Safely	3 Moderately safely	2 Fairly safely	1 Not safely
Cut sapling	4 Safely	3 Moderately safely	2 Fairly safely	1 Not safely
Cut branches between ground level and shoulder height	4 Safely	3 Moderately safely	2 Fairly safely	1 Not safely
Cut branches over the head	4 Safely	3 Moderately safely	2 Fairly safely	1 Not safely

EVALUATOR'S COMMENTS

____

____

____

AVERAGE RATING

Evaluator note: To obtain an average rating for the competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

PERFORMANCE EVALUATION KEY

4 – Skilled—Can perform job with no additional training

3 – Moderately skilled—Has performed job during training program, limited additional training may be required

2 – Limited skill—Has performed job during training program; additional training is required to develop skill

1 – Unskilled—Is familiar with process, but is unable to perform job

PRACTICAL TEST 2

IDENTIFY AND USE BASIC TOOLS OF FORESTRY

VII

JOB SHEET 2

Use a shovel properly.

Student's name ____________________________ Date ____________

Evaluator's name ___________________________ Attempt no. _____

Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

Evaluator note: Write a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.

The student:	YES	NO
Dig a hole 2 feet in diameter and 8 inches deep.		
1. Determined location and marked area of hole.	_____	_____
2. Checked shovel and handle for broken or weak points.	_____	_____
3. Put on gloves.	_____	_____
4. Placed the shovel at about an 80° angle to the ground.	_____	_____
5. Pressed shovel into the soil with the right or left foot.	_____	_____
6. Bent the knees and scooted the forward hand toward the head of the shovel.	_____	_____
7. Tilted the shovel back.	_____	_____
8. Placed the rear hand so the shovel was balanced and neither arm held all or most of the weight.	_____	_____
9. Straightened the legs and lifted the shovel up.	_____	_____
10. Turned the whole body away from the hole, feet and shoulders facing the same way.	_____	_____
11. Rotated the handle with wrists so the dirt fell from the shovel.	_____	_____
12. Continued until hole was 2 ft around and 8 in deep.	_____	_____

The student:	YES	NO
Spread dirt with a shovel		
1. Took a position between the dirt and the spread area.	______	______
2. Grasped the shovel with both hands, one hand forward on the handle.	______	______
3. Stepped toward the dirt with the same foot forward as the forward hand on the shovel.	______	______
4. Bent the knees slightly and scooped up a shovelful of dirt about knee-to-hip high.	______	______
5. Swung around, using the foot nearest the dirt pile as a pivot, and placing the other foot near the spread area.	______	______
6. Tilted the shovel to keep the dirt in front of it for an even spread.	______	______
7. Used a *short* thrust forward and up to throw the dirt, keeping arms slightly bent at all times.	______	______
8. Continued throwing dirt until the hole was filled.	______	______
9. Tamped and leveled soil by walking on it and filled level to the ground.	______	______
10. Spread any remaining dirt evenly.	______	______
11. Removed soil, mud, or other foreign matter from the shovel by scraping or washing with water or both.	______	______
12. Stored the shovel in a dry, safe place.	______	______
13. Used proper tools correctly.	______	______
14. Performed steps in a timely manner.	______	______
15. Practiced safety rules throughout procedure.		
16. Provided satisfactory responses to questions asked.	______	______
17. Put away tools and cleaned work area.	______	______

EVALUATOR'S COMMENTS

____

____

____

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See performance evaluation key). A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:

Used shovel	4 Safely	3 Moderately safely	2 Fairly safely	1 Not safely
Dug a hole	4 2′ x 8"	3 ± 2"	2 ± 3"	1 Error exceeded 3"
Filled area	4 Even and level	3 Moderately even and level	2 Fairly even and level	1 Not acceptable

EVALUATOR'S COMMENTS

AVERAGE RATING

Evaluator note: To obtain an average rating for the competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

PERFORMANCE EVALUATION KEY

4 – Skilled—Can perform job with no additional training

3 – Moderately skilled—Has performed job during training program, limited additional training may be required

2 – Limited skill—Has performed job during training program; additional training is required to develop skill

1 – Unskilled—Is familiar with process, but is unable to perform job

JOB SHEET 3

Sharpen a double-bitted ax with a file.

Student's name ____________________________ Date ___________

Evaluator's name __________________________ Attempt no._____

Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

Evaluator note: Write a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.

The student:	YES	NO
1. Drove one edge of the ax into the stump so it stood straight up.	_____	_____
2. Stood to one side of the ax, with both feet on the same side of the handle.	_____	_____
3. Held file with one hand on the handle and fingers safely curved away from the ax blade.	_____	_____
4. Tapped the file on the stump occasionally to knock metal filings out of the file teeth.	_____	_____
5. Filed across the cutting edge at a slight angle to remove knicks.	_____	_____
6. Applied light pressure with the forefingers and kept other fingers curled away from the blade.	_____	_____
7. Filed in one direction only.	_____	_____
8. Continued filing until the edge was smooth.	_____	_____
9. Held the file at a slight angle to sharpen the edge.	_____	_____
10. Worked from the top of the blade toward the stump.	_____	_____
11. Filed in one direction only.	_____	_____
12. Kept the original bevel.	_____	_____
13. Continued until the edge was smooth and correctly beveled for the length of the blade.	_____	_____

The student:	YES	NO
14. Walked to the other side and repeated the procedure.	______	______
15. When finished, removed ax from stump, turned and set the sharpened bit into the stump.	______	______
16. Repeated procedures to sharpen the other bit.	______	______
17. Used proper tools correctly.	______	______
18. Performed steps in a timely manner.	______	______
19. Practiced safety rules throughout procedure.	______	______
20. Provided satisfactory responses to questions asked.	______	______
21. Put away tools and cleaned work area.	______	______

EVALUATOR'S COMMENTS

____

____

____

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See performance evaluation key). A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:				
Used file	4 Safely	3 Moderately safely	2 Fairly safely	1 Not safely
Edge	4 Even bevel	3 Moderately even bevel	2 Fairly even bevel	1 Not acceptable

EVALUATOR'S COMMENTS

____

____

____

AVERAGE RATING

Evaluator note: To obtain an average rating for the competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

PERFORMANCE EVALUATION KEY

4 – Skilled—Can perform job with no additional training

3 – Moderately skilled—Has performed job during training program, limited additional training may be required

2 – Limited skill—Has performed job during training program; additional training is required to develop skill

1 – Unskilled—Is familiar with process, but is unable to perform job

NAME ______________________________ SCORE ________

OBJECTIVE 1

Match terms associated with the basic tools of forestry to their correct definitions. Write the correct letters in the blanks.

____ 1. A short length of wire rope or chain that forms a noose around the end of a piece of wood to be skidded

____ 2. A tong-like device used to pick up logs for skidding and loading logs and wood

____ 3. Edges are angled to create a sharp cutting surface

____ 4. Gross vehicle weight

____ 5. Working part of a hand tool attached to the handle, made of metal

____ 6. Moved by the force or pressure of liquid

____ 7. Place where logs are accumulated (also called a yard)

____ 8. Sawing logs into short lengths

____ 9. Sharp particles left on edges after filing or sharpening

____ 10. To cut dead or living parts from a plant in order to increase fruit or flower production; to improve the form or to remove dead or diseased parts

____ 11. To drag logs or tree lengths either wholly or partially on the ground

a. Beveled
b. Bucking
c. Burr
d. Choker
e. Cutting edge
f. Grapple
g. G.V.W.
h. Head
i. Hook and eye
j. Hydraulic
k. Lines and ties
l. Log deck
m. Prune
n. Skid
o. Water pressure
p. Wood lot

OBJECTIVE 2

Match tools to their uses. Write the correct letters in the blanks.

____1. Brightly colored tape for marking

____2. Cuts into soil for setting seedlings and fertilizer pellets

____3. Digs and lifts loose sand and soil

____4. A book used to identify soil types; contains aerial maps of the county and other useful information

____5. Used to identify trees

____6. Used to plant tree seedlings on slopes or in hilly terrain

____7. Removes branches larger than 1 1/4" in diameter

____8. Used to remove leaves and twigs to clear fire break

____9. Used for rolling logs

___10. Sprays herbicide; used with a backpack pressure spray tank

___11. Used to survey boundaries, identify map locations, locate specific sites, and find direction

___12. Used in logging for cutting small brush, for driving wedges, for chopping out a saw stuck in a cut; used in fire fighting for cutting limbs and small trees to remove potential fuel from a fire

___13. Used for general-purpose cutting and prying

___14. Used for digging in hard surfaces

___15. Used to figure acreage; estimate volume, weight, and value of timber; find slope, etc.

___16. Used to move pulpwood logs into position on logging trucks

a. Ax
b. Compass
c. *County Soil Survey*
d. Crosscut saw
e. Debarker
f. Drill
g. Folding knife
h. Hand saw
i. Hoe
j. Hookeroon
k. ID Key
l. Peavey and canthook
m. Pick
n. Planting bar
o. Plastic flagging
p. Pocket calculator
q. Pruning saw
r. Rakes
s. Shears
t. Shovel
u. Spade
v. Spotgun applicator
w. Spray paint
x. Transit
y. Tree directory
z. Tree inhibitor

___ 17. Describes soil type, characteristics, suitability for various land uses

___ 18. Inserted into wood behind a chainsaw to keep saw blades from being pinched in a cut; used to start a tree falling in the right direction

___ 19. Sprays paint spot on trees to be cut or left uncut

___ 20. Used to survey boundaries, identify map locations, locate specific sites, and find direction

aa. Tree injector
bb. Tree-marking gun
cc. Tree spike
dd. Tree spotter
ee. SPI Sheets
ff. SRI Sheets
gg. Wedges
hh. Vents

OBJECTIVE 3 **State safety rules for using hand tools.** Write ten safety rules.

____

____

____

____

____

____

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____

____

____

OBJECTIVE 4 **Select from a list true statements about correct use of the body to avoid injuries.** Write an "X" in the blank before each true statement.

____ 1. Hold the tool close to your body rather than stretching or using a long reach.

____ 2. Hold wrists straight and use the elbow for leverage, not the shoulder or wrist.

____ 3. Keep arms and legs straight when using hitting tools such as axes and Pulaskis.

____ 4. Keep shoulders, hips and feet aligned; don't twist the back.

____ 5. Keep wrists bent and use the elbow and shoulder for leverage.

____ 6. Keep your weight balanced.

____ 7. Let the weight of the tool carry it into the soil; keep elbows bent, pull in short strokes.

____ 8. Never pick up a load that is too heavy.

____ 9. Put your full weight behind hitting tools such as axes, hammers, and picks.

____ 10. Use the strongest muscles, arms and back, for lifting; use weaker muscles in legs for pushing and pulling.

____ 11. Use leverage rather than lifting or pushing whenever possible.

____ 12. Use your legs to lift, not your back.

OBJECTIVE 5

State procedures for maintaining hand tools. Write six procedures.

____

____

____

____

____

____

____

____

OBJECTIVE 6 **Match types of power equipment to their uses.** Write the correct letters in the blanks.

____ 1. Break up pulpwood logs and limbs for sale to paper mills and wood products manufacturers

____ 2. Carry and hold fuel for operating heavy equipment, power plants and trucks

____ 3. Cuts trees and carries several at once for row thinning, clearcutting and heavy pulpwood cutting operations

____ 4. Drag cut material such as logs, limbs, and brush out of the woods

____ 5. Haul dirt and gravel for building logging roads

____ 6. Used for a variety of jobs such as pushing, stacking and lifting logs, dozing and leveling yard areas

____ 7. Provides access to remote areas, carrying limited amount of personnel and equipment; used to patrol fire lines during a controlled burn; and to seed logging roads

____ 8. Removes limbs and branches from whole trees

____ 9. Run lights and equipment for mechanical harvesting

___ 10. Used to finish-cut and level roads

___ 11. Used to lift logs from the ground to a log-hauling truck

___ 12. Used to rough-cut roads and drainages, level ground, push over trees, pull stumps, move slash and rubble, and haul logs

___ 13. Used for felling timber, delimbing, and bucking logs

___ 14. Haul products from logging operations to market

___ 15. Haul equipment

___ 16. Unloads logging trucks

a. All-Terrain Vehicle
b. Backhoe
c. Chainsaw
d. Chippers
e. Crane
f. Crosscut saw
g. Delimber
h. Dozers
i. Dump trucks
j. Feller-buncher
k. Stacker
l. Front-end loader
m. Fuel trucks
n. Graders
o. Grapple
p. Loaders
q. Logging trucks
r. Lowboys
s. Power Plants
t. Scraper
u. Skidders
v. Trailers
w. Tree shears
x. Winches
y. Steel-track cat

OBJECTIVE 7 **List safety equipment.** Write seven items.

NOTICE The following assignment sheets and job sheets are not part of the written test. If these activities have not been completed, check with your instructor.

OBJECTIVE 8 **Identify hand tools used in forestry.** SCORE ________

OBJECTIVE 9 **Identify power equipment used in forestry.** SCORE ________

OBJECTIVE 10 **Design a tool kit.** SCORE ________

OBJECTIVE 11 **Analyze accidents involving tools.** SCORE ________

OBJECTIVE 12 **Demonstrate the ability to**

a. **Use an ax properly.** RATING ______

b. **Use a shovel properly.** RATING ______

c. **Sharpen a double-bitted ax with a file.** RATING ______

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WRITTEN TEST ANSWERS

IDENTIFY AND USE BASIC TOOLS OF FORESTRY

VII

OBJECTIVE 1

1. d
2. f
3. a
4. g
5. h
6. j
7. l
8. b
9. c
10. m
11. n

OBJECTIVE 2

1. n
2. m
3. s
4. e
5. k
6. i
7. q
8. r
9. l
10. v
11. b
12. a
13. g
14. m
15. p
16. j
17. ee
18. gg
19. aa
20. bb

OBJECTIVE 3

Answer should include any ten of the following:

- Always use a tool as it is designed to be used.
- Stay alert any time you use tools.
- Never use tools when you are tired or in a hurry.
- Keep tools in their proper places.
- Do not leave tools on the ground near work site.
- Put tools down with edges facing into the ground.
- Inspect tools before use and often during use.

- Keep cutting edges sharp.
- Hold sharp or pointed tools so that the point is not in line with your body.
- Carry shovels and other tools with the heads behind you.
- Carry and use long-handled tools so they won't hit others working nearby.
- Locate all underground utility lines and pipes before digging.
- Wear appropriate clothing for the job.

OBJECTIVE 4 1, 2, 4, 6, 7, 8, 11, 12

OBJECTIVE 5 Answer must include any six of the following:

- Keep tools clean.
- Keep tools free of rust.
- Check tools often and tighten or replace screws, bolts, handles and heads as needed.
- Sharpen or replace dull cutting edges.
- Repair broken or damaged tools promptly.
- Dispose of broken tools that cannot be repaired.
- Keep moving parts oiled.
- Oil wooden handles with linseed oil to prevent drying and splitting.

OBJECTIVE 6

1. d
2. m
3. j
4. u
5. i
6. l
7. a
8. g
9. s
10. n
11. p
12. h
13. c
14. q
15. r
16. k

OBJECTIVE 7

Answer should include all of the following:

- Hard hat
- Safety glasses
- Gloves
- Hard-toed shoes
- Ear protection
- Chaps
- First-aid kit

OBJECTIVE 8

Refer to answers to Assignment Sheet 1.

OBJECTIVE 9

Refer to answers to Assignment Sheet 2.

OBJECTIVE 10

Refer to answers to Assignment Sheet 3.

OBJECTIVE 11

Refer to answers to Assignment Sheet 4.

OBJECTIVE 12

Refer to Practical Test Ratings for Job Sheets 1 through 3.

OBJECTIVE SHEET

USE BASIC MATH FOR FORESTRY

VIII

INTRODUCTION

Math is an important skill in daily life, and in many careers. It is especially important in forestry. Some common calculations include figuring land area; estimating timber value; figuring tree size and weight; determining costs and profits; predicting fire behavior; determining the age of trees; estimating damage from fire, disease and insects; and making tree measurements.

PREREQUISITES

None

UNIT OBJECTIVE

After completing this unit, the student should know standard measures and their equivalents, common formulas and be able to perform basic calculations used in forestry. The student will demonstrate these competencies by completing the assignment sheets and written test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with basic math for forestry to their correct definitions.
2. Match standard measures to their equivalents.
3. Label parts of a circle.
4. Calculate perimeter.
5. Match formulas for area to their shapes.
6. Match formulas for volume to their shapes.
7. Describe a representative fraction scale.
8. Solve conversion problems. (Assignment Sheet 1)
9. Use conversion charts to find distance and area in forestry measures. (Assignment Sheet 2)
10. Solve forestry problems of length and area. (Assignment Sheet 3)
11. Solve forestry problems of volume and weight. (Assignment Sheet 4)
12. Calculate the weight of trees. (Assignment Sheet 5)
13. Calculate mix ratios. (Assignment Sheet 6)

14. Determine scale, distance, and area on aerial photographs. (Assignment Sheet 7)

PREPARATION

- Obtain materials to supplement unit.

  NOTE: See Suggested Resources.

- Review instructional outline for this unit. Modify time frames to suit class needs and plan activities for each class period.

- Study specific objectives to determine those you will cover in your presentation. Decide which objectives should be taught to which students.

- Determine scope and sequence of objectives that you add. Design and develop support materials, including evaluation techniques, for additional objectives.

- Determine how you will schedule time for students to demonstrate competence in the required procedures.

- Invite a forester, forestry employee, or a forestry consultant to discuss the ways in which math is used on the job.

  NOTE: Supply guest speakers with the specific objectives and other appropriate sections of the unit.

DELIVERY

Objective 1

- Stress the need for good math skills in all aspects of life, and particularly in forestry careers.

- As a warmup, give the class problems to solve involving common classroom activities.

- Use the Information Sheet to stimulate a quick review of basic math principles and functions.

- Invite a forester, forestry employee, or forestry consultant to discuss the ways in which math is used on the job.

Objective 2

- Discuss with students standard measures and their equivalents.

- Ask students to list their own common uses of equivalents in activities such as mixing feed or fuel, cooking, etc.

- Refer students to Supplements 1 and 2 on metric measures.

- Demonstrate how to make standard conversions.

- Give students some practice conversions before they complete the assignment sheet.

- Have students complete Assignment Sheet 1.

Objectives 3 and 4

- Review parts and principles of a circle and perimeter.

- Have students discuss ways in which knowing the parts of circles might be important in forestry.

Objective 5

- Discuss the formulas for area.

- Refer students to Supplement 2.

- Let students measure different lengths and areas.

- Have students name common area measurements they are familiar with and review the formulas for finding the area involved, such as the classroom, the school lot, the surface area of a small, medium and large pizza, etc.

- Refer students to Supplement 3.

- Have students complete Assignment Sheet 3.

Objective 6

- Discuss formulas for volume.

- Ask students to name various shapes of which they might want to know the volume. Look for ideas such as how much water will a culvert hold? How much will a pickup bed hold? What is the volume of feeding buckets?

- Refer students to Supplement 3.

- Have students complete Assignment Sheet 4.

Objective 7

- Discuss representative fractions and RF scale.
- Let students make a map of the classroom using an RF scale. Measure with fun units such as a hat, a pencil length, etc.
- Show students USGS maps of your state with various scales. Refer to Unit 11, Supplements 3, 4, and 6
- Have students complete Assignment Sheet 7.

APPLICATION

Objective 8

- Use Assignment Sheet 1 to give students practice in converting U.S. and metric units.

Objective 9

- Give students practice using the conversion charts by providing local distances and measures.
- Use Assignment Sheet 2 to give students experience using conversion charts to find distance and area used in forestry measures. Supplements 5 and 6 contain conversion charts.

Objective 10

- Use Assignment Sheet 3 to give students the opportunity to work on realistic problems involving length and area.

Objective 11

- Use Assignment Sheet 4 to give students the opportunity to work on realistic problems involving volume and weight.

Objective 12

- Demonstrate the formula for finding the area of a cone.
- Use Assignment Sheet 5 to help students learn how to determine volume of a cone and give them an appreciation of the size and weight of trees.

Objective 13

- Demonstrate the procedure for calculating mix ratios and give students practice exercises.

- Use Assignment Sheet 6 to give students practical experience with ratio calculations.

Objective 14

- Use Part 1 of Assignment Sheet 7 to introduce students to measuring distance, determining RF scale and calculating distance.
- For Part 2, use the *Soil Survey* book for your county to provide aerial maps. Have students apply skills in measurement and scale to determine area and percentage.
- The *Soil Survey* can also be used for an activity in which students locate their homes and measure the distances to local landmarks.

EVALUATION

Written test

- Explain to students that they will be asked to demonstrate on the written test actions listed in the specific objectives.
- Give written test.

  NOTE: The written test may be given in sections if desired.
- Evaluate students on assignment sheet activities if not previously done.
- Reteach and retest if necessary.
- Complete appropriate section of competency profiles.
- Review individual and group performance in order to evaluate teaching methods. Adjust scope, sequence, or instructional approaches for additional lessons as required.

SUGGESTED RESOURCES

- Obtain United States Geological Survey (USGS) maps of various scale, or a copy of a map book to teach RF scale. This book will be used in Unit 11, Use Legal Land Descriptions.
- Obtain the *Soil Survey* book for your county, available from the Soil Conservation Office. It contains aerial photographs and information that can be used with Assignment Sheet 7. You may want to create a loose-leaf file so maps can be reused.

- Request old aerial photographs from your Soil Conservation Office so that each student can have a map to keep.

UNIT REFERENCES

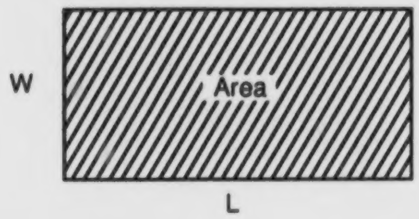
- *Basic Horticulture*, Curriculum and Instructional Materials Center, Oklahoma Department of Vocational and Technical Education, Stillwater, Oklahoma, 1989.
- Greenhood, David, *Mapping*, The University of Chicago Press, Chicago, Illinois, 1964.
- Perky, Sandra Dutreau, *Highway Maintenance Equipment Operator*, Vol. 1, Curriculum and Instructional Materials Center, Oklahoma Department of Vocational and Technical Education, Stillwater, Oklahoma, 1982.

OBJECTIVE 1

Match terms associated with basic math for forestry to their correct definitions.

- **Area**—Measure of a flat surface having length and width; expressed in square units

  EXAMPLE:



  W x L = Area in square units

- **Decimals**—Fractions based on the number 10; not written as common fractions

  EXAMPLES: $\frac{1}{10} = 0.1$ $\frac{6}{100} = .06$ $\frac{3}{1000} = 0.003$

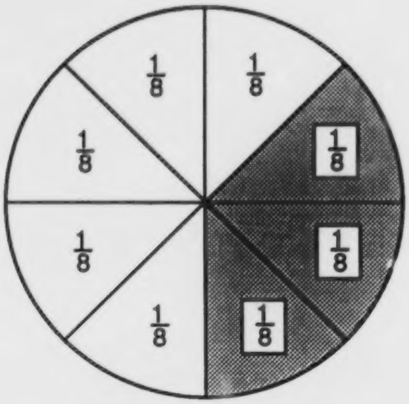
  $\frac{6}{12} = .5$ $\frac{3}{12} = .25$ $\frac{4}{12} = .33$

- **Denominator**—Bottom number of the fraction; tells into how many equal parts the whole is divided

  EXAMPLE: 3/8; 8 is the denominator.

- **Fraction**—Part of a whole; represents one or more equal parts of a unit

EXAMPLE: If the unit is divided into eight equal parts, then each part is one-eighth (1/8) of the unit; the fraction three-eighths (3/8) means three of the parts, as shown in the shaded portion of the figure below.

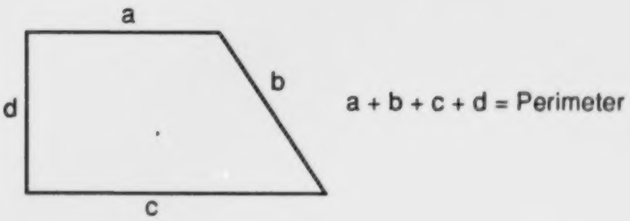


- **Numerator**—Top number of the fraction; tells how many equal parts of the whole are being considered

EXAMPLE: 3/8; 3 is the numerator.

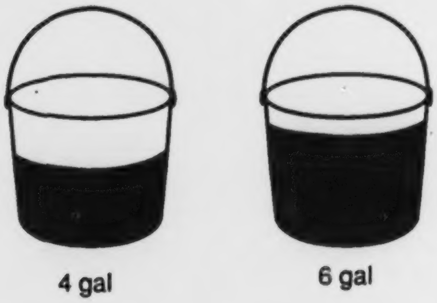
- **Perimeter**—Outer limits or boundary of a space

EXAMPLE:



- **Pi**—The ratio of circumference to diameter in a circle, equal to 3.14 to two decimals places.
- **Ratio**—Comparison of one quantity with another like quantity or value using the : symbol or a division bar

EXAMPLE: **a:b or $\frac{a}{b}$**



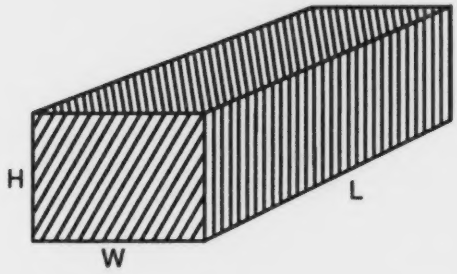
The ratio, or relationship of the material in bucket a to the material in bucket b, is 4:6 or 4/6; stated, "four to six."

- **Slope or grade**—Describes the relationship between the horizontal distance and the vertical distance of two points expressed in percent or feet

NOTE: Slope or grade is used to describe hillsides, road grades, mountain slopes, etc. Percent slope is calculated by dividing the vertical distance by the horizontal distance.

- **Volume**—Space occupied by a body having length, height, and width, expressed in cubic units

EXAMPLE:



L x W x H = Volume in cubic units

OBJECTIVE 2 **Match standard measures to their equivalents.**

NOTE: * indicates the number has been rounded off.

Linear measure

US

12 inches (in) = 1 foot (ft)
3 ft = 1 yard (yd)
36 in = 1 yd.
1,760 yd = 1 mile (mi)
5,280 ft = 1 mile
63,360 in = 1 mile
16.5 ft = 1 rod or pole
66 ft = 1 chain (ch)
7.92 in = 1 link
100 links = 1 ch
80 ch = 1 mile

Metric

1 centimeter (cm) = .4* in (.3937)
1 meter (m) = 39.37 in
1 kilometer (km) = .6* m (.62)
1 mile = 1.6 km
1 rod or pole = 5 m
1 chain = 20 m* (20.1)
1 link = .2 m
1 foot = .3* m (.3048)

Surface measure

NOTE: Expressed in square units = ft^2

144 in^2 = 1 ft^2
9 ft^2 = 1 yd^2
4,840 yd^2 = 1 acre
640 acres = 1 mile^2
10 ch^2 = 1 acre
43,560 ft^2 = 1 acre
1 acre = .4 hectares
1 hectare (ha) = 2.5* acres (2.47)

Cubic measure

1,728 in^3 = 1 ft^3
27 ft^3 = 1 yd^3
128 ft^3 = 1 cord firewood
100 ft^3 = 1 cunit firewood

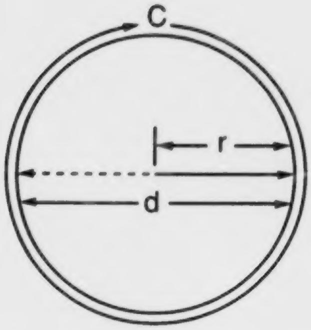
Weight

16 ounces (oz) = 1 pound (lb)
2,000 lbs = 1 ton (T)
1 Kilogram (Kg) = 2.2 lbs
1000 grams (g) = 1 kg

Liquid measure

16 oz = 1 pint (pt)
2 pt = 1 quart (qt)
32 oz = 1 qt
4 qt 1 gallon (gal)
1 gal water = 8 1/2 lbs
7 1/2 gal = 1 ft^3
55 gal = 1 drum (Barrel-bbl)
30 gal = 1/2 bbl
1 liter (l) = 1* qt (1.05)
1 gal = 3.78 l

OBJECTIVE 3 Label parts of a circle.



r = radius = $\frac{d}{2}$

d = diameter = 2r

C = circumference = πd or $2 \pi r$

Area = πr^2 or $\frac{\pi d^2}{4}$

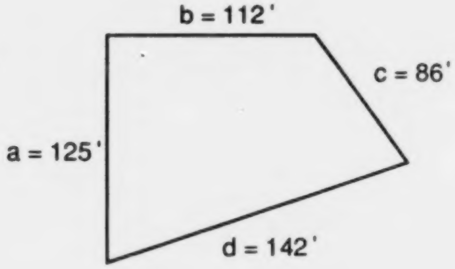
OBJECTIVE 4

Calculate perimeter.

Perimeter—sum of the lengths of all sides

NOTE: Perimeter is always expressed in linear inches, feet, yards, chains, links, miles, etc.

EXAMPLE: a + b + c + d, etc.



Perimeter = a + b + c + d
= 125 + 112 + 86 + 142
= 465 feet

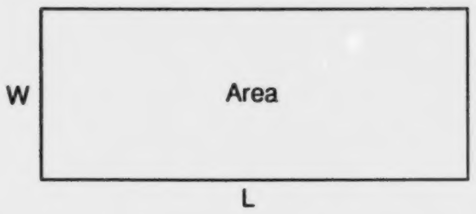
OBJECTIVE 5

Match formulas for area to their shapes.

- **Area of a Rectangle** = Length x Width

  NOTE: Surface area is expressed in square inches, feet, yards, miles, acres, etc.

  EXAMPLE: A = L x W



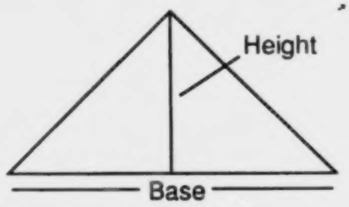
A Christmas tree sales lot is 200 feet long and 150 feet wide. What is the area?

A = L x W
  = 200 x 150
  = 30,000 sq ft

- **Area of a triangle** = 1/2 x Base x Height

  NOTE: Area is expressed in square inches, feet, yards, acres, etc.

  EXAMPLE: A = 1/2 x B x H



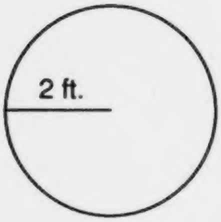
What is the surface area of a triangular piece of plywood, 3 feet high and 6 feet across?

A = 1/2 x B x H
  = 1/2 x 3 x 6
  = 9 sq ft
  = 1 sq yd

- **Area of a circle** = Pi x Radius squared

  NOTE: Area of a circle is expressed in square inches, feet, yards, etc.

  EXAMPLE: πr^2 or $\frac{\pi d^2}{4}$ $\pi = 3.14$



$\Pi \cdot r^2$

$3.14\,(2^2)$

$3.14 \cdot 4$

12.56

A tree stump has a radius of 6 in. What is the area of a cross section of the stump?

$$\pi r^2 = 3.14 \text{ x } 6^2$$
$$= 3.14 \text{ x } 36$$
$$= 113.04 \text{ in}$$

Since $d = 2r$, $d = 12$

$$\frac{\pi d^2}{4} = \frac{3.14 \text{ x } 12^2}{4}$$

$$= \frac{3.14 \text{ x } 144}{4}$$

$$= \frac{452.16}{4}$$

$$= 113.04$$

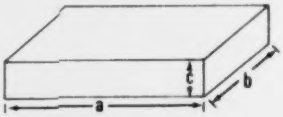
OBJECTIVE 6

Match formulas for volume to their shapes. (Supplement 4, Assignment Sheet 4)

- **Volume of a box =** Length x Width x Height

  NOTE: Volume is expressed in cubic inches, feet, yards, miles, etc.

  EXAMPLE: V = L x W x H



How much wood is in a pickup loaded with chips? The truck bed measures 4 ft wide, 8 ft long and 3.5 ft high.

V = L x W x H
= 8 x 4 x 3.5
= 112 cu ft
= 112 cu ft ÷ 27 = cu yd
= 4.15 cu yd

- **Volume of a cylinder =** π x Radius^2 x height

  NOTE: Volume is expressed in cubic inches, feet, yards, etc.

  EXAMPLE: $V = \pi r^2 h$ $\pi = 3.14$

How much wood is in a 4 ft log with a radius of 5 1/2 in?

Convert feet to inches:

4 x 12 = 48

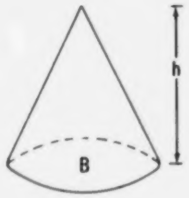
$V = \pi r^2 h$
= 3.14 x 5.5 x 48
= 3.14 x 30.25 x 48
= 4,559.28 cu in
= 4,559.28 ÷ 1,728 = cu in
= 2.63 cu ft

- **Volume of a cone** = 1/3 x area of the base x height

  $1/3\pi r^2h$

  NOTE: Volume is expressed in cubic inches, feet, yards, etc.

  EXAMPLE: $1/3\pi r^2h$



How much water is in a round pond 150 feet across, sloping to a middle depth of 12 feet?

NOTE: The degree of accuracy will vary according to how many places the decimal is carried to.

$$\begin{aligned} V &= 1/3\pi r^2h \\ &= 1/3 \times 3.14 \times 75^2 \times 12 \\ &= 1/3 \times 3.14 \times 5{,}625 \times 12 \\ &= 1/3 \times 211{,}950 = (.33 \times 211{,}950 \text{ or } \frac{211{,}950}{3}) \end{aligned}$$

OBJECTIVE 7

Describe a representative fraction scale.
(Supplement 4, Assignment Sheet 7)

- RF stands for representative fraction.

- A representative fraction means that the scale is a fraction of the actual distance it stands for. The fraction represents any measure used.

  If you built a 1/200 model of your house, you know that the model you have made is 200 times smaller than the actual house. On a map with a scale of 1:10,000, the shapes, the roads, the landmarks represent the same places on the map, one-ten-thousandth the actual size.

- Compare this actual distance to a common scale such as "1 inch equals 32 miles." You must convert inches to miles. Another map may read "8 miles to the inch." With RF scales, inches stand for inches or feet for feet, with no confusion and no change from map to map.

- The ratio is the same regardless of the unit of measurement: inches, meters, centimeters, yards—it could even be hand-widths or match sticks —such that with a ratio of 1:62,500, 1 inch or hand-print on the map is equal to 62,500 inches or hand-prints on the actual land.

- The representative fraction can be written as an actual fraction or as a ratio:

  $\frac{1}{62,500}$ or 1:62,500 $\frac{1}{250,000}$ or 1:250,000

  The numerator is always 1 and represents the map.

  The denominator is always a much larger number and represents the ground.

- To get the distance between two points on the map, **multiply the map distance by the denominator.**

  EXAMPLES:

  - Scale 1:100,000Distance on the map: 2 1/2 inches

    2 1/2 in (or 2.5) x 100,000 = 250,000 in

    250,000 in ÷ 63,360 in (in a mile) = 3.95 mi

- The same map distance in centimeters is 6 cm

  6 x 100,000 = 600,000 cm ÷ 100 cm = 6,000 m

  6,000 m ÷ 1,000 m = 6 km

- Common RF scales:

  1:24,000 1:25,00 1:62,500 1:100,000 1:250,000

  1:500,000 1:1,000,000 1:2,000,000 1:2,500,000

  and up to 1:80,000,000

METRIC MEASURES

The metric system is based on multiples of 10.

Linear measure

10 millimeters (mm)	= 1 cm		
10 cm	= 1 decimeter (dm)	= 100 mm	
10 dm	= 1 meter(m)	= 100 cm	= 1,000 mm
10 m	= 1 dekameter (dam)		
10 dam	= 1 hectometer (hm)	= 100 m	
10 hm	= 1 km	= 1,000 m	

Area measure

100 square millimeters (mm^2)	= 1 sq centimeter (cm^2)	
10,000 square centimeters	= 1 sq meter (m^2)	= 1,000,000 sq millimeters
100 square meters	= 1 are (a)	
100 ares	= 1 hectare (ha)	= 10,000 sq meters
100 hectares	= 1 sq kilometer (km^2)	= 1,000,000 sq meters

Volume measure

10 milliliters (ml)	= 1 centiliter (cl)	
10 centiliters	= 1 deciliter (dl)	= 100 milliliters
10 deciliters	= 1 liter (l)	= 1,000 milliliters
10 liters	= 1 dekaliter (dal)	
10 dekaliters	= 1 hectoliter (hl)	= 100 liters
10 hectoliters	= 1 kiloliter (kl)	= 1,000 liters

Cubic measure

1,000 cubic millimeters (mm^3)	= 1 cu centimeter (cm^3)		
1,000 cubic centimeters	= 1 cu decimeter (dm^3)	= 1,000,000 cu millimeters	
1,000 cubic decimeters	= 1 cu meter (m^3)	= 1 stere	= 1,000,000 cu centimeters
	= 1,000,000,000 cu millimeters		

Weight

10 milligrams (mg)	= 1 centigram (cg)	
10 centigrams	= 1 decigram (dg)	= 100 milligrams
10 decigrams	= 1 gram (g)	= 1,000 milligrams
10 grams	= 1 dekagram (dag)	
10 dekagrams	= 1 hectogram (hg)	= 100 grams
10 hectograms	= 1 kilogram (kg)	= 1,000 grams
1,000 kilograms	= 1 metric ton (t)	

METRIC CONVERSION FACTORS

Area

When You Know	Multiply By	To Find
square centimeters	0.16	square inches
square meters	1.20	square yards
square kilometers	0.39	square miles
hectares (10,000m^2)	2.47	acres
square inches	6.45	square centimeters
square feet	0.09	square meters
square yards	0.84	square meters
square miles	2.60	square kilometers
acres	0.40	hectares

Mass and Weight

When You Know	Multiply By	To Find
grams	0.035	ounce
kilograms	2.21	pounds
tons (100kg)	1.10	short tons
ounces	28.35	grams
pounds	0.45	kilograms
short tons (200kg)	0.91	tons

Speed

When You Know	Multiply By	To Find
miles per hour	1.61	kilometers per hour
kilometers per hour	0.62	miles per hour

Temperature (exact)

When You Know	Multiply By	To Find
Celsius temp.	9/5 and add	Fahrenheit temp.
Fahrenheit temp.	5/9 and subtract	Celsius temp.

Volume

When You Know	Multiply By	To Find
liters	1.06	quarts
liters	0.26	gallons
cubic meters	35.32	cubic feet
cubic meters	1.35	cubic yards
teaspoons	4.93	milliliters
tablespoons	14.78	milliliters
fluid ounces	29.57	milliliters
cups	0.24	liters
pints	0.47	liters
quarts	0.95	liters
gallons	3.79	liters

Length

When You Know	Multiply By	To Find
millimeters	0.04	inches
centimeters	0.39	inches
meters	3.28	feet
meters	1.09	yards
kilometers	0.62	miles
inches	25.40	millimeters
inches	2.54	centimeters
feet	30.48	centimeters
yards	0.91	meters
miles	1.61	kilometers

Volume

When You Know	Multiply By	To Find
cubic feet	0.03	cubic meters
cubic yards	0.76	cubic meters

FORMULAS

Area of a rectangle

$A = L \times W$

Area of a triangle

$A = 1/2 \times B \times H$

Area of a circle

πr^2 or $\frac{\pi d^2}{4}$

Volume of a right-angle object

$V = L \times W \times H$

Volume of a cylinder

$V = \pi r^2 h$

Volume of a cone

$V = 1/3 \pi r^2 h$

Radius of a circle

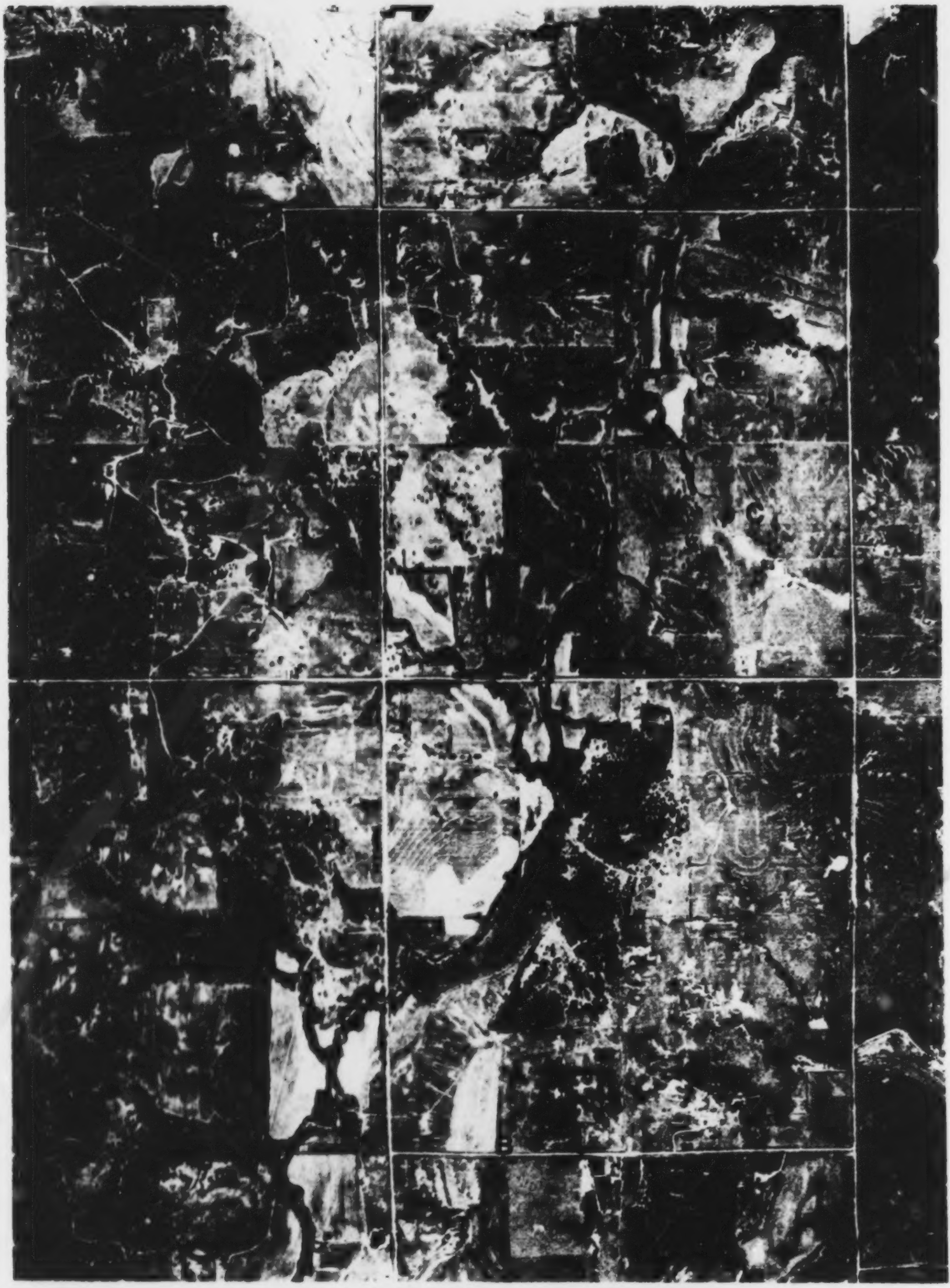
$r = \frac{d}{2}$

Diameter of a circle

$d = 2r$ or $\frac{C}{\pi}$

Circumference

$C = \pi d$ or $2\pi r$



CONVERSION FACTORS FOR LENGTH

Inches	Links	Feet	Yards	Rods	Chains[1]	Miles[2]	Centimeters	Meters	Kilometers
1[3]	0.126263 (1/8)	0.083333 (1/12)	0.027778 (1/36)	0.00505 (1/200)	- - - - -	- - - - -	2.540005 (2 1/2)	0.0254 (1/40)	- - - - -
7.92	1	0.66 (2/3)	0.22	0.04 (1/25)	0.01 (1/100)	- - - - -	20.11684 (20)	0.201168 (1/5)	- - - - -
12	1.515152 (1 1/2)	1[3]	0.333333 (1/3)	0.060606 (1/16)	0.015152 (1/66)	0.000189	30.48006 (30)	0.304801 (3/10)	0.000305
36	4.545455 (4 1/2)	3	1[3] (1/5)	0.181818 (1/15)	0.045455	0.000568	91.44018	0.914402 (9110)	0.000914
0.3937 (2/5)	0.04971 (1/20)	0.032808 (1/30)	0.010936 (1/90)	- - - - -	- - - - -	- - - - -	1[4]	0.01	- - - - -
39.37 (40)	4.97096 (5)	3.280833	1.09361	0.198838 (1/5)	0.04971 (1/20)	0.000621 (1/1600)	100	1	0.001
							Furlongs		
198	25	16.5	5.5	1	0.25 (1/4)	0.003125 (1/320)	0.025 (1/40)	5.02921 (5)	0.005029 (1/200)
792	100	66	22	4	1	0.0125 (1/80)	0.1	20.1168 (20)	0.020117 (1/50)
	- - - - -	5,280	1,760	320	80	1	8	1,609.347 (1,600)	1.609347 (1 3/5)
	- - - - -	660	220	40	10	0.125 (1/8)	1	201.168	0.201168 (1/5)
	- - - - -	3,280.83	1,093.61	198.838 (200)	49.7096 (50)	0.62137 (518)	4.97096 (5)	1,000	1

[1] Surveyor's chain; the engineer's chain = 100 links of 1 foot each is not used.

[2] 1 nautical mile (termed "knot" as unit of velocity) = 1.1516 statute miles = 1.85325 km = 1 minute of arc on the earth's surface at the Equator.

[3] British units: 1 yard = 0.914399 m; 1 foot = 30.47997 cm; 1 inch = 2.539998 cm; 1 hand = 4 inches = 10.16 cm; 1 span = 9 inches = 22.86 cm; 1 cubit = 18 inches - 45.72 cm.

[4] 1 millimeter = 0.1 cm = 0.03937 inch = 0.00328 foot.

Source: U.S. Department of Agriculture

CONVERSION FACTOR FOR AREA

Square inches	Square links	Square feet	Square yards	Square chains	Acres	Square centimeters	Square meters	Hectares	Square kilometers
1	0.015942 (1/63)	0.006944	- - - - -	- - - - -	- - - - -	6.451626 (6 1/2)	0.000645	- - - - -	- - - - -
62.7264 (63)	1	0.4356 (3/7)	- - - - -	0.0001	0.00001	404.6873	0.040469 (1/25)	- - - - -	- - - - -
144	2.295684	1	0.111111 (1/9)	0.00023	0.000023	929.034	0.092903 (1/11)	- - - - -	- - - - -
1,296	20.6612 (20)	9	1	0.002066 (1/500)	0.000207	8,361.31	0.836131 (4/5)	- - - - -	- - - - -
0.155 (1/7)	- - - - -	0.001076 (1/1000)	- - - - -	- - - - -	- - - - -	1[1]	0.0001	- - - - -	- - - - -
1,549.997	24.7104	10.76387 (11)	1.19599 (1 1/5)	0.002471 (1/400)	0.000247	10,000	1	0.0001	- - - - -
	10,000	4,356	484	1[2]	0.1	Square Miles 0.000156 (1/6400)	404.687	0.040469 (1/25)	0.000405 (1/2500)
		43,560	4,840	10	1[3]	0.0015625 (1/540)	4,045.87 (4,000)	0.404687 (2/5)	0.004047 (1/250)
		27,878,400	3,097,600	6,400	640	1	2,589,998	258.9998 (260)	2.589998 (2 3/5)
		107,638.7	11,959.9 (12,000)	24.7104 (25)	2.471044 (2 1/2)	0.003861 (1/250)	10,000	1	0.01
		10,763,867	1,195,985	2,471.04	247.104 (250)	0.386101 (2/5)	1,000,000	100	1

[1] 1 mm 2 = 0.01 cm 2 = 0.00155 square inch.

[2] 1 square chain - 16 square rods.

[3] 1 acre = area 208.710 (210) feet square = 3.16 chains square.

Source: U.S. Department of Agriculture

ASSIGNMENT SHEET 1

USE BASIC MATH FOR FORESTRY

VIII

NAME ______________________________ SCORE_______

OBJECTIVE 8 **Solve conversion problems.**

INTRODUCTION

Forestry operations involve the use of many different materials. Any application requires correct amounts of those materials. Knowing how to compute units of measure and basic volumes is a skill you will use throughout your life.

All quantities or distances in a problem must be expressed in like terms.

Refer to Objective 2 in the Information Sheet for measures and equivalents.

EXAMPLES: Feet + feet, inches ÷ inches, gallons + gallons, yards x yards.

You **cannot** perform any mathematical operations with unlike terms such as quarts and gallons. You must convert one of the quantities to the same measure as the other or others. It is usually better to convert larger units to smaller units; but if the problem is simple enough, it is faster and easier to convert from smaller units to larger units.

Multiply to convert larger units to smaller units.

EXAMPLE: Convert 8 gallons to quarts.

8 x 4 = 32 quarts

Divide to convert from smaller units to larger units.

EXAMPLE: Convert 32 quarts to gallons.

32 ÷ 4 = 8 gallons

DIRECTIONS Provide the information as stated below.

Conversions:

PART 1

Use Objective 2 of the Information Sheet as needed to convert the following measures. Round off answers to the nearest tenth.

1. 48 in = ________ ft

2. 312 ft = ________ yd

3. 8 yd^3 = ________ ft^3

4. 7 yd^2 = ________ ft^2

5. 11 gal = ________ qt

6. 6 pt = ________ qt

7. 3/4 mi = ________ ft

8. 1260 ft^2 = ________ yd^2

9. 246 in^2 = ________ ft^2

10. 5120 acres = ________ mi^2

11. 128 oz = ________ qt

12. 396 in = ________ yd

13. How many quarts are in a 55-gal drum?____________ qts

14. How many cubic yards of soil are in 3,078 ft^3?_______ yd^3

PART 2

Use Supplement 2 to convert U.S. units to metric units. Round off answers to the nearest tenth.

1. 32 in = ________ cm

2. 15 mi = ________ km

3. 802 in^2 = ________ cm^2

4. 420 yd^2 = ________ m^2

5. 160 lb = ________ kg

6. 32° F = ________ ° C

7. 98.6° F = ________ ° C

8. 12 gal = ________ l

9. 3 pt = ________ l

10. 55 mph = ________ km/hr

ASSIGNMENT SHEET 2

USE BASIC MATH FOR FORESTRY

VIII

NAME ______________________________ SCORE _______

OBJECTIVE 9

Use conversion charts to find distance and area in forestry measures.

INTRODUCTION

When you have to convert chains into feet, feet into rods or meters, square feet to square yards or acres, the easiest way is to use a conversion chart. Tables for converting length measurements and area or surface are given in Supplements 5 and 6. Many other charts, such as weight and volume tables, are available for forestry work. They are found in handbooks and texts and can make all kinds of measuring jobs faster and easier.

Foresters use the 66-foot Gunter chain as the basic measure. Chains are used because the arithmetic is easy when converting chains to other measures:

> 1 chain, 66 feet, divides evenly into 5,280 feet (1 mile) and 43,560 square feet (1 acre), so that
>
> 1 chain = 66 feet
> 80 chains = 1 mile
> 40 chains = 1/2 mile
> 20 chains = 1/4 mile
> 10 square chains = 1 acre
> 1 chain = 20 meters
>
> **NOTE:** Engineers also use chains as a standard measure, but engineering chains are 100 feet long and must not be confused with foresters' chains.

DIRECTIONS

To use conversion charts in Supplements 5 and 6, find the measurement you have on the chart and read across to the equivalent you want, to the left for smaller units, or to the right for larger units and metric measures. You then multiply or divide, according to the answer you are looking for.

Since there are always more units in the smaller denomination than in the larger, you multiply if your answer is to be in the smaller denomination, such as feet, and you divide if it is to be in the larger denomination, such as miles.

EXAMPLE:

Inches	Links	Feet	Yards	Rods	Chains	Miles	Centimeters	Meters	Kilometers
792	100	66	22	4	1	0.0125	0.1	20.1	0.02

1. A fence line is 12 chains. How many feet?

   Find the column for chains and move left to read the column for feet.

   Multiply 12 x 66 to find the number of feet.

2. Seedling trees are to be planted every 4 inches for a distance of 15 chains. How many trees are needed?

   Look to the left and find the conversion to inches, or

   Convert chains to inches by multiplying 12 in x 66 ft.
   Multiply 792 in x 15 chains and divide by 4 in.

3. The perimeter of the Perez acreage is 3,840 feet. How many chains?

   Locate the number of feet in a chain and divide: 3,840 ÷ 66.

PART 1

Select conversion factors from Supplement 5 to solve the following problems. Show your work and write the answers in the blanks.

Problem: A township line is 6 miles long. Determine the distance in each of the following equivalents. Round off answers to the nearest tenth.

1. How many chains would be measured? ____________________

2. How many feet? ____

3. How many rods or poles? _______________________________

4. How many kilometers? __________________________________

5. How far is 4 inches on a map with a scale of 1:21,000? ____

PART 2

Select conversion factors from Supplement 6 to solve the following problems. Show your work and write the answers in the blanks.

Problem: Determine the area around a fire that is square in shape. The total distance around the perimeter is 8800 yards. Find the equivalents.

NOTE: Use the formulas for finding the area of a square: L x W. It might help you to draw the fire area.

1. What is the length of each side of the square? ____________

2. What is the area in square yards? ______________________

3. How many acres? ___________________________________

4. How many square chains? ____________________________

5. How many square feet? ______________________________

6. How many hectares? _________________________________

ASSIGNMENT SHEET 3 — USE BASIC MATH FOR FORESTRY — VIII

NAME ______________________________ SCORE _______

OBJECTIVE 10 **Solve forestry problems of length and area.**

INTRODUCTION

Measures of length and area are important to all spatially-related tasks, from painting a room to building a house or designing a highway. Working with these dimensions is a major part of forestry work. To determine the value of a stand of trees, the forester measures and calculates the total area, the number of trees in that area, and the value of the trees per acre.

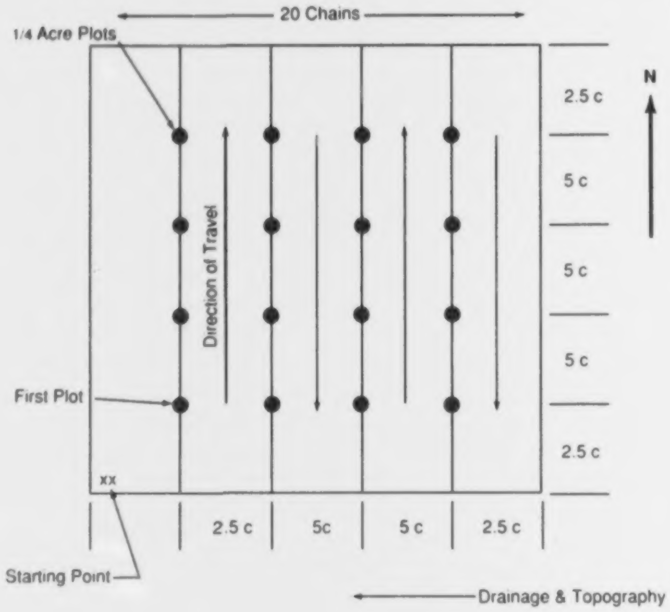
DIRECTIONS

Answer the questions below. Show your work. Round off answers to the nearest tenth.

1. A rectangular parcel of land 136 ft. by 200 ft. contains how many
   a. square chains? __________
   b. acres? __________________

2. A rectangular piece of land 3.5 chains by 20 chains contains how many
   a. square chains? __________
   b. acres? __________________

3. **Timber cruising is sampling the forest for information such as board feet per acre of sawlog-size trees. One way to sample is by plots, as shown here:**


20 Chains
1/4 Acre Plots
N
2.5 c
5 c
5 c
5 c
2.5 c
Direction of Travel
First Plot
xx
Starting Point
2.5 c
5c
5 c
2.5 c
Drainage & Topography

a. What is the total tract acres in the above figure?

_______________acres

b. If these are 1/4 acre plots, what is the total area measured?

_______________acres

c. What proportion are these samples of the total tract acreage expressed as a ratio? ___________________

4. Many U.S. Geological Survey maps are drawn to the scale of 1:125,000.

   Two inches on the map = ___________ miles on the ground.

5. The circular plot is often used for taking samples of forest areas. A commonly used size has a radius of 52.7 feet.

   a. What is its diameter? ____________ feet

   b. What is its circumference? _____________ feet

   c. How many square feet? _____________ sq feet

   d. What portion of an acre is this expressed as a fraction?

   ____

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ASSIGNMENT SHEET 4

USE BASIC MATH FOR FORESTRY

VIII

NAME ______________________________ SCORE _______

OBJECTIVE 11

Solve forestry problems of volume and weight.

INTRODUCTION

How much wood can be loaded on a truck? How much hardwood and softwood on a stand of a certain size? How much money can be made on a certain volume or weight of wood? How much wood can be cut in an hour with a certain type of saw? These are typical problems involving volume and weight.

DIRECTIONS

Solve the problems below using formulas in Supplement 3 and guidelines in the Information Sheet. Round off answers to the nearest tenth.

1. A cylindrical tank on a fire fighting water pump truck is 14 feet long and has a diameter of 6 feet.

   a. How many cubic feet does it have? _____________

   b. How many gallons of water will it hold? ________

2. A pile of wood chips used to make paper is 100 ft high and has a base diameter of 240 ft.

   a. How many cubic feet in the pile? ______________

   b. What does it weigh if a sample of one cubic foot weighs 36 lbs? ___________

3. Fuel wood can be sold green or dry. A cord of oak weighs about 5700 lbs green and 4100 lbs dry. If you had a contract for 9 tons only:

   a. How many cords of green wood would you deliver? __________

   b. How many cords of dry wood? __________

4. How many standard cords are on a railroad car stacked 8 ft wide, 28 ft long, and 7 ft high? ________________________

5. An airplane used for fire fighting carries 1200 gallons per load of fire retardant solution. The retardant will be sprayed over trees in danger of catching fire at the rate of one load per 1.6 acres. If a gallon of solution weighs 8.34 lb, how many pounds of solution per square foot are applied to the trees? Round off your answer to the nearest hundredth.

   ____________ lbs.

NAME ______________________________ SCORE _______

OBJECTIVE 12

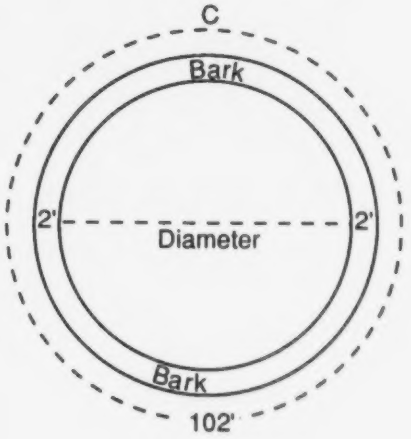
Calculate the weight of trees.

INTRODUCTION

Since timber is sold by weight, foresters use several methods to determine the amount of salable wood in a stand or the weight of wood after harvest.

This method uses the formula for volume of a cone to find weight.

EXAMPLE: The General Sherman Sequoia tree has a circumference at the base of 102 ft, bark thickness is 2 ft at the base, height is 272 ft. If we assume the trunk to be a true cone and use 40 lbs. per cu. ft. as the weight, what is the weight of the wood?



Remember you are finding the weight of only the **wood** per cubic foot.

1. Find the diameter.

$$\frac{C}{\pi} = d$$

$$\frac{102}{\pi} = 32.48$$

2. Find the diameter of the wood without the bark. Subtract the bark from the diameter.

$d = 32.48 - 4 = 28.48$ ft

3. Convert diameter to radius

$$\frac{d}{2} = r$$
$$\frac{28.48}{2} = 14.24$$

4. Find the volume of a cone

$$v = \frac{\pi r^2 h}{3}$$

$$v = \frac{3.14 \times (14.24^2) \times 272}{3}$$

$= 57,729.43$

5. Find the weight of only the wood per cubic foot.

40 lbs x 57,729.43 = 2,309,177.23 lbs

DIRECTIONS

Find the weight of wood using the volume of a cone method. Show your work.

Steps to find the weight of wood in a tree:

1. Find the diameter $\frac{C}{\pi} = d$
2. Subtract the bark d - (bark x 2)
3. Find the radius $\frac{d}{2} = r$
4. Find the volume of a cone $v = \frac{\pi r^2 h}{3}$
5. Find the weight

1. What is the weight of a tree with a circumference of 7.64 feet, bark 3/4" thick, and a height of 60 ft? The wood weighs 50 lbs per cu ft.

   Hint: Remember to convert feet to inches to work with the bark thickness.

   ______________ lbs

2. Find the weight of wood in a pulpwood tree 19 inches in circumference, with 3/8" thick bark, 35 ft high. The wood weighs 40 lbs per cu ft.

   Hint: Convert the fraction to a decimal.

   ______________ lbs

3. Find the weight of wood in a high-value black walnut tree with a circumference of 68", bark thickness of 1", a height of 65 ft and weighing 43 lbs per cu ft.

   Hint: Convert feet to inches.

   ______________ lbs

NAME ________________________________ SCORE ________

OBJECTIVE 13 **Calculate mix ratios.**

INTRODUCTION

Using mix ratios is common in forestry work. Chainsaws require a ratio of oil to gas. Herbicides, pesticides, and fertilizers are mixed in ratios. Soil and water analysis, chemical formulas and the chemical composition of trees and of wood are often expressed in ratios.

Ratios compare only like quantities such as gallons to gallons, feet to feet. You cannot have a ratio of inches to feet.

To calculate ratio:

1. Figure out the terms of the ratio.

The order of numbers in a ratio corresponds to the order of materials or objects as stated:

EXAMPLE: Mix sand and gravel to a ratio of 2:1 OR
Mix gravel and sand to a ratio of 1:2
(Sand and gravel are used in making concrete)
Sand - 2 parts (it may be 2 cups, 2 cubic feet, cubic yards, 5-gal buckets, 50-lb sacks, tons, etc.)
Gravel - 1 part of the same measure

2. Reduce ratio to lowest terms for easier handling.

   EXAMPLES: 3:180 = 1:60 4:12 = 1:3 7:25 = 3:1

3. Divide the given amount by the number of parts to find one part.

   EXAMPLE: You have 36 yd^3 of sand, how much 3/4" gravel will you need to mix a 3:2 ratio of 1/4" and 3/4" gravel?

   To find one part: 36 ÷ 3 = 12 (1 part)

4. Multiply that amount by the number of parts of the unknown quantity or quantities.

   12 x 2 = 24 yd^3 of 3/4" gravel

   So the ratio states that you will use 36 yd^3 of 1/4" gravel and 24 yd^3 of 3/4" gravel. 36:24 = 3:2, with 12 as the common denominator.

PRACTICE QUESTION:

How much of each material would you need to make a 40:20:20 mixture of sand, hardwood bark and pine bark for planting seedlings in a nursery if each pot requires 4 lbs of mixture? How much to fill 200 pots?

	One pot	200 pots
Sand	________ lb	________ lb
Hardwood bark	________ lb	________ lb
Pine bark	________ lb	________ lb

DIRECTIONS

Solve the following mix ratio problems.

1. An unusually cold winter has seriously threatened the food supply for the birds around a lake in your forestry district. You want to mix a wild bird seed of millet and sunflower seeds in a 3:1 ratio. You have 300 lbs of millet. How much bird seed will you need?

   ______________ lbs

2. How much herbicide concentrate will be added to 100 gal of water if the ratio is 1 part herbicide to 400 parts water?

   ______________ qt

3. How much liquid fertilizer concentrate will be added to 5 gal of water if the ratio is 1 part fertilizer to 320 parts water? (Calculate the number of ounces in a gallon.)

   ______________ oz

4. How much tree-marking dye will be added to 2.5 qts of chemical base if the ratio is 2 parts dye to 16 parts base? (Find out how many ounces are in a quart.)

   ______________ oz

5. The fuel mixture ratio of gasoline to two-cycle engine oil is 20:1 for your chain saw. How much oil will you add to 5 gal of gas?

______________ qt

6. With a 20:1 ratio of gas to oil, how much oil is added to 1 gal of gas?

______________ oz

7. You are helping with the construction of a concrete picnic table base. The concrete mix calls for a 3:2:1 mixture of sand, gravel and Portland cement. If you pick up one 50-lb sack of cement, how much sand and gravel are needed?

______________ lb sand

______________ lb gravel

8. Your fire fighting crew is having a fish fry. You are to make the tartar sauce of pickle relish, mayonnaise, and lemon juice at a ratio of 1.5:2:0.2. You estimate that one 32-oz jar of mayonnaise will be enough. How much pickle relish and lemon juice will you mix with the mayonnaise?

______________ oz pickle relish

______________ oz lemon juice

ASSIGNMENT SHEET 7

USE BASIC MATH FOR FORESTRY

VIII

NAME ______________________________ SCORE _______

OBJECTIVE 14

Determine scale, distance, and area on aerial photographs.

INTRODUCTION

The ability to read maps and determine scale and distance is extremely important in many areas of forestry. Professional foresters and forestry technicians are trained in map reading and in reading aerial photography. The information from maps can be used to survey a tract; project fire behavior, water flow, timber value; to determine management practices, land ownership, distance and area, and for other forestry activities. Foresters use the *Soil Survey* for the county they are working in because it contains aerial maps of the entire county and other information such as soil conditions and rainfall information.

RF scales are increasingly popular and are replacing the more familiar "1 inch = X miles" in technical fields.

To determine scale:

1. **Identify a known distance on a photo or map.** For example a 1-mile section, five 1-mile sections, etc.
2. **Measure that distance.** For this example we will use inches. (Remember that the measuring tool can be a ruler measuring in inches, centimeters, or millimeters, a length of string, a piece of paper, a thumb-width etc.)

HINT: Use decimals for easier calculations.

EXAMPLE: A distance of 1 mile equals 5.25 inches on the map.

3. **Convert to the same measure.** You can convert miles to inches OR inches to feet. Converting to feet is easier because you work with smaller numbers.

EXAMPLE: 1 mile = 63,360 in OR $\frac{5.25}{12}$ in = .4375 ft = .44

4. **Write the fraction.**

EXAMPLE: $\frac{63{,}360 \text{ in}}{5.25 \text{ in}}$ OR $\frac{5{,}280 \text{ ft}}{.44 \text{ ft}}$

5. **Divide to find the ratio.**

EXAMPLE: $\frac{63{,}360}{5.25}$ in = 12,068.57 OR $\frac{5{,}280}{.44}$ ft =

SCALE 1:12,069 OR 1:12,000

NOTE: The difference in these two figures is due to rounding off the fractions.

To determine distance on the ground in miles:

1. Multiply the denominator by the distance on the map.
2. **Convert the number to miles.** You can divide by 63,360 (inches in a mile) or by 12 and then by 5,280.

EXAMPLE: If the distance from point A to point B is 6.5 inches
6.5 x 12,000 = 78,000 in
78,000 ÷ 63,360 = 1.23 mi
OR
78,000 ÷ 12 = 6,5000
6,500 ÷ 5,280 = 1.23 mi

3. **Check to see that the answer makes sense.** Does it look right on the map?

PART 1

DIRECTIONS

Determine the scale and distances on the aerial map in Supplement 4. The distance between section lines is 1 mile. Determine distances in miles and round off to the nearest tenth.

1. What is the measured distance in inches between section lines?

____

2. What is the scale? Show your work.

______________ Scale

3. What is the distance between points A and B?

4. What is the distance between points B and C?

5. What is the distance between points A and D?

6. What is the map distance between section lines in centimeters?

7. What is the distance between points A and B in km?

PART 2

DIRECTIONS

Find the approximate percentage of area of a particular soil in a section.

The *Soil Survey* map shows the different types of soil in an area by number. A section of land is 1 mile by 1 mile and can be identified by the roads or section lines.

Your teacher will select a section to be measured.

1. Treat the selected soil areas as circles or rectangles and measure them with a ruler for an approximate measure.
2. Use the scale to determine the land area.
3. Make a ratio of the area of a certain soil and the area of the section, then divide the denominator into the numerator to find the percentage.

   Soil type number

   Ruler measurement

   RF scale equivalent and value

   (sq. ft, acres, miles, etc.)

   Ratio (decimal or fraction)

   Percentage

ASSIGNMENT ANSWERS

USE BASIC MATH FOR FORESTRY

VIII

ASSIGNMENT SHEET 1

PART 1

1. 4 ft
2. 104 yd
3. 216 ft^3
4. 63 ft^2
5. 44 qt
6. 3 qt
7. 3,960 ft
8. 140 yd^2
9. 1.7 ft^2
10. 8 mi^2
11. 4 qt
12. 11 yd
13. 220 qt
14. 114 yd^3

PART 2

1. 82.05 cm
2. 24.15 km
3. 5012.5 cm^2
4. 352.8 m^2
5. 72 kg
6. 0°C.
7. 37°C.
8. 45.5
9. 1.4 l
10. 88.55 km/hr

ASSIGNMENT SHEET 2

PART 1

1. 480 ch
2. 31,680 ft
3. 1,920 rods or poles
4. 9.7 km
5. 1.33 mi

PART 2

1. 2200 yds
2. 4,840,000 yd^2
3. 1,001.9 acres
4. 9999.4 ch^2

5. 560,000 ft^2
6. 400 ha

ASSIGNMENT SHEET 3

1. a. 6.3
   b. .63
2. a. 70
   b. 7
3. a. 40
   b. 4
   c. 10%, 1/10, 1:10
4. 3.95
5. a. 105.4 ft
   b. 330.96 ft
   c. 8720.69 ft^2
   d. 1/5

ASSIGNMENT SHEET 4

1. a. 395.6 ft^3
   b. 2,967.3
2. a. 1,507,200 ft^3
   b. 54,259,200 lbs
3. a. 3.16
   b. 4.39
4. 12.25 cds
5. 6.96 lbs
   43,560 x 1.6 = 69,696

ASSIGNMENT SHEET 5

1. Convert feet measurements to inches by multiplying by 12

   1. Convert feet measurements to inches by multiplying by 12
      7.64 x 12 = 91.68 inches

      $\frac{c}{\pi} = d \qquad \frac{91.68}{3.14} = 29.20$

   2. d - (2 x bark) = 29.20 - (2 x .75) = 27.70

   3. $\frac{d}{2} = r \qquad \frac{27.70}{2} = 13.85$

   4. $\frac{\pi r^2 h}{3} = \frac{3.14 \times (13.85)^2 \times 720}{3} = 433{,}672.31 \text{ in}^3$

      Convert cubic inches to cubic feet by diving by 1728

      $\frac{433{,}672.31}{1728} = 250.97 \text{ ft}^3$

   5. $50 \times 250.97 \text{ ft}^3 = 12{,}548$ lbs

2. $\frac{19}{3.14} = 6.05$

   2 x 3/8 = 6/8 6/8 = .75

   6.05 – .75 = 5.30

   5.30 ÷ 2 = 2.65

   $\frac{3.14 \times (2.65)^2 \times 420}{3} = 3{,}087.09 \text{ in}^3$

   $\frac{3{,}087.09}{1728} = 1.79 \text{ ft}^3$

   40 x 1.79 = 71.46 lbs

3. 1,963.07 lb.

ASSIGNMENT SHEET 6

Practice question

Reduce: 40:20:20 to 2:1:1

	One pot	200 pots
Sand	2 lb	400 lb
Hardwood bark	1 lb	200 lb
Pine bark	1 lb	200 lb

1. 100 lbs
2. 1 qt
3. 2 oz
4. 10 oz
5. 1 qt
6. 6.4 oz
7. 150 lb sand
   100 lb gravel
8. 24 oz pickle relish
   3.2 oz lemon juice

ASSIGNMENT SHEET 7

NOTE: Answers may vary according to the ruler measurement. Check the inch or centimeter measurement and math when answers are slightly different.

PART 1

1. 3 inches
2. 1:21,120 $\frac{3}{12} = .25$ $\frac{5,280}{.25} = 21,120$
3. 1.9 21,120 x 5.75 = 121,440 ÷ 63,360 = 1.916 = 1.9
4. 1.4 21,120 X 4.12 [4 1/8] = 87,014.4 ÷ 63,360 = 1.37 = 1.4
5. .4 21,120 X 1.12 [1 1/8] = 23,654.4 ÷ 63,360 = .37 = .4
6. 7.5 cm
7. 3 km 21,120 x 14.3 cm = 302,016 100,000 = 3.02

PART 2

Soil type number

Ruler measurement

RF scale equivalent and value
(sq. ft, acres, miles, etc.)

Ratio (decimal or fraction)

Percentage

WRITTEN TEST

USE BASIC MATH FOR FORESTRY

VIII

NAME ______________________________ SCORE _______

OBJECTIVE 1

Match terms associated with basic math for forestry to their correct definitions. Write the correct letters in the blanks.

____ 1. Comparison of one quantity with another like quantity or value using the : symbol or a division bar

____ 2. Measure of a flat surface having length and width; expressed in square units

____ 3. Space occupied by a body having length, height, and width, expressed in cubic units

____ 4. Part of a whole; represents one or more equal parts of a unit

____ 5. Describes the relationship between the horizontal distance and the vertical distance of a slope expressed in feet

____ 6. Bottom number of the fraction; tells into how many equal parts the whole is divided

____ 7. Outer limits or boundary of a space

____ 8. Fractions based on the number 10; not written as common fractions

____ 9. Top number of the fraction; tells how many equal parts of the whole are being considered

___ 10. The ratio of circumference to diameter in a circle, equal to 3.14 to two decimal places

a. Angle

b. Area

c. Capacity

d. Comparison

e. Decimals

f. Denominator

g. Divisor

h. Fraction

i. Numerator

j. Outline

k. Perimeter

l. Pi

m. Ratio

n. Slope ratio

o. Supernumerator

p. Tenth

q. Volume

OBJECTIVE 2

Match standard measures to their equivalents. Write the correct answers in the blanks. Some items require more than one answer.

Linear measure

_______ 1. 1 mi
_______ 2. 1 link
_______ 3. 1 yd
_______ 4. 1 ft
_______ 5. 1 ch
_______ 6. 1 m
_______ 7. 1 cm
_______ 8. 1 rod or pole
_______ 9. 1 km

a. 39.37 in
b. 3 ft
c. 4,840 ft
d. 16.5 ft
e. 66 ft
f. 1,760 yd
g. .6 m
h. 7.92 in
i. 5,280 ft
j. 1.6 km
k. .2 m
l. .4 in
m. 36 in
n. 5 m
o. 3 m
p. 80 ch
q. 10 ch
r. 63,360 in
s. .3 m
t. .5 in
u. 12 in
v. 40 in
w. 20 m
x. 1,000 yd
y. 100 links

Surface measure

_______ 1. 1 yd^2
_______ 2. 1 mi^2
_______ 3. 1 acre
_______ 4. 1 ft^2
_______ 5. 1 hectare

a. 320 acres
b. 640 acres
c. .4 hectares
d. 100 ch^2
e. 9 ft^2
f. 2.5 acres
g. 4,840 yd^2
h. 36 in^2
i. 10 ch^2
j. 144 in^2
k. 43,560 ft^2

Cubic Measure

____ 1. 1 yd^3
____ 2. 1 cord firewood
____ 3. 1 ft^3
____ 4. 1 unit firewood

a. 2,122 in^3
b. 27 ft^3
c. 100 ft^3
d. 120 ft^3
e. 1,728 in^3
f. 128 ft^3

Weight

____ 1. 1 kg
____ 2. 1 ton
____ 3. 1 lb

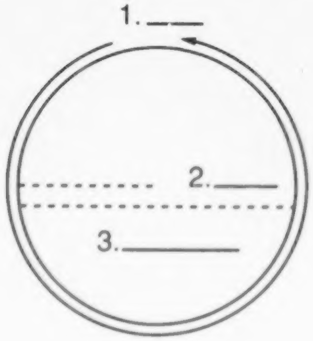
a. 2000 lbs
b. 1,000 lbs
c. 16 oz
d. 32 oz
e. 2.2 lbs
f. 2 lbs

Liquid measure

____ 1. 1 pt
____ 2. 1 qt
____ 3. 1 gal
____ 4. 1 ft3
____ 5. 1 bbl
____ 6. 1/2 bbl

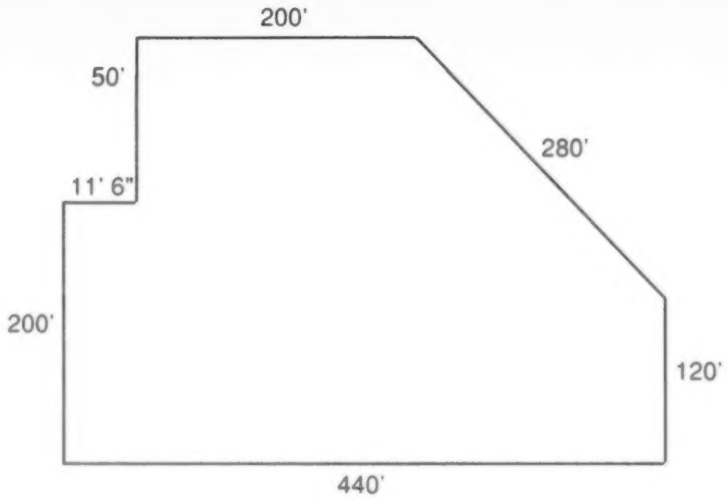
a. 7 1/2 gal
b. 25 gal
c. 1 liter
d. 8 1/2 lb
e. 4 qt
f. 2 pt
g. 30 gal
h. 16 oz
i. 55 gal
j. 3.78 liter
k. 32 oz

OBJECTIVE 3 **Label parts of a circle.**



OBJECTIVE 4

Calculate perimeter. Find the perimeter of the land tract below. Show your work.



OBJECTIVE 5

Match formulas for area to their shapes. Write the correct letters in the blanks.

____ 1. Rectangle
____ 2. Circle
____ 3. Triangle

a. πd^2
b. L x W
c. L + W
d. B x H
e. πr^2
f. 1/2 x B x H

OBJECTIVE 6 **Match formulas for volume to their shapes.** Write the correct letters in the blanks.

____1. Cone	a. $\pi r^2 h$
____2. Rectangular box	b. $3\pi r^2 h$
____3. Cylinder	c. $L \times W \times H$
	d. $1/3\ \pi r^2$
	e. $1/3\ \pi r^2 h$

OBJECTIVE 7 **Describe a representative fraction scale.** Tell what is meant by the RF scale 1:25,000 and how the scale is used to determine distance.

____

____

____

____

____

____

____

NOTICE The following assignment sheets are not part of the written test. If these activities have not been completed, check with your instructor.

OBJECTIVE 8 **Solve conversion problems.** SCORE ________

OBJECTIVE 9 **Use conversion charts to find distance and area in forestry measures.** SCORE ________

OBJECTIVE 10 **Solve forestry problems of length and area.** SCORE ________

OBJECTIVE 11 **Solve forestry problems of volume and weight.** SCORE ________

OBJECTIVE 12 **Calculate the weight of trees.** SCORE ________

OBJECTIVE 13	**Calculate mix ratios.**	SCORE _______
OBJECTIVE 14	**Determine scale, distance, and area on aerial photographs.**	SCORE _______

OBJECTIVE 1

1. m
2. b
3. q
4. h
5. n
6. f
7. k
8. e
9. i
10. l

OBJECTIVE 2

Linear measure

1. i, f, j, p, r
2. h, k
3. b, m
4. s, u
5. e, w, y
6. a
7. l
8. d, n
9. g

Surface measure

1. e
2. b
3. i, c, k
4. j
5. f

Cubic measure

1. b
2. f
3. e
4. c

Weight

1. e
2. a
3. c

Liquid measure

1. h
2. c, f, k
3. e, d, j
4. a
5. i
6. g

OBJECTIVE 3

1. Circumference
2. Radius
3. Diameter

OBJECTIVE 4

1,301' 6"

OBJECTIVE 5

1. b
2. e
3. f

OBJECTIVE 6

1. e
2. c
3. a

OBJECTIVE 7

Answer should include the following:

- The scale represents any measure used.
- The 1 represents the actual distance on the map and the 25,000 represents the actual distance on the ground.
- To find the distance on the ground, the distance on the map is multiplied by 25,000, or the denominator.

OBJECTIVE 8 Refer to answers to Assignment Sheet 1.

OBJECTIVE 9 Refer to answers to Assignment Sheet 2.

OBJECTIVE 10 Refer to answers to Assignment Sheet 3.

OBJECTIVE 11 Refer to answers to Assignment Sheet 4.

OBJECTIVE 12 Refer to answers to Assignment Sheet 5.

OBJECTIVE 13 Refer to answers to Assignment Sheet 6.

OBJECTIVE 14 Refer to answers to Assignment Sheet 7.

OBJECTIVE 15 Refer to answers to Assignment Sheet 8.

OBJECTIVE SHEET

PRACTICE TREE MEASUREMENT

IX

INTRODUCTION

Taking tree measurements is a basic learning skill for beginning foresters and one of the major activities for many professional foresters and technicians. Measurements are the raw data for estimating timber value and for planning harvesting and forest management activities. In good weather, taking tree measurements and cruising can be some of the most enjoyable work in forestry. In the summer heat when the mosquitoes, gnats, and snakes are out, it can be some of the hardest work. These skills are easy to learn, fun to do, and can teach you to see trees in a new way.

PREREQUISITES

Unit VI: *Practice Forest Safety*
Unit VII: *Identify and Use Basic Tools*
Unit VIII: *Use Basic Math for Forestry*

UNIT OBJECTIVE

After completing this unit, the student should recognize the tools used in measuring trees, know the characteristics of correct measurement practices, and be able to perform basic tree measurements. The student will demonstrate these competencies by completing the assignment sheets, job sheets, and written test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with tree measurements to their correct definitions.
2. Name tools used in taking tree measurements.
3. Classify DBH measurements into the correct diameter classes.
4. Determine the correct location of DBH measurements.
5. Complete statements concerning merchantable height.
6. Distinguish among the major log scales.
7. Draw tally symbols.
8. Determine merchantable height of trees. (Assignment Sheet 1)
9. Complete a tally sheet. (Assignment Sheet 2)
10. Calculate estimated volume, weight, and value of timber. (Assignment Sheet 3)

11. Demonstrate the ability to

    a. Measure diameter using a diameter tape. (Job Sheet 1)

    b. Measure diameter using a Biltmore stick. (Job Sheet 2)

    c. Measure height using a Biltmore stick. (Job Sheet 3)

    d. Measure merchantable height using a Suunto clinometer. (Job Sheet 4)

SUGGESTED ACTIVITIES

PRACTICE TREE MEASUREMENT IX

PREPARATION

- Obtain materials to supplement unit.

  NOTE: See Suggested Resources.

- Review instructional outline for this unit. Modify time frames to suit class needs and plan activities for each class period.

- Study the specific objectives to determine those you will cover in your presentation. Decide which objectives should be taught to which students.

- Determine scope and sequence of objectives that you add. Design and develop support materials, including evaluation techniques, for additional objectives.

- Determine how you will schedule time for students to demonstrate competence in the required procedures.

- Invite a professional forester or forestry technician to discuss why tree measurements are important and tools used in tree measurements.

- Have a forester demonstrate the use of an increment borer and interpret the information gained from the wood core.

- Invite a forester to analyze the tally sheet in Assignment Sheet 2 or other tally sheets; describe the plot according to the tally and make recommendations for plot, tract or forest management based on the data.

  NOTE: Supply guest speakers with specific objectives and other appropriate sections of the unit.

DELIVERY

Objective 1

- Write the terms on the board and see how many the students already know.

- Share your own experiences in taking tree measurements.

- Stress to interested students that tree measurements are a part of the FFA Forestry Contest.

- Let students know that this unit provides basic forestry skills needed in cruising, which they will be learning in Unit 12.

- Discuss collecting data and the conclusions or information that can be derived from the data. Draw on students' own experiences, such as measuring fish, heights and sizes of corn or other produce, rainfall, IQ, growth patterns, etc.

- Invite a forester to talk with the class about the importance of taking accurate tree measurements and their uses in forestry.

Objective 2

- Show tools to students and let them handle them.

- Demonstrate the use of tools and discuss safety precautions, proper handling, maintenance, etc.

Objectives 3 and 4

- Make a list of tree diameter sizes and let students compete or collaborate to facilitate rapid responses in determining correct diameter classes.

- Take students on a tour of a forest or park to assess trees for the correct location of DBH measurements.

Objectives 5 and 6

- Discuss the decisions involved in determining merchantable height. Draw analogies from students' own experience with merchantable characteristics of livestock or crops.

- Have students complete Assignment Sheet 1.

- Take students on a field trip to help them learn the characteristics of merchantable height.

Objective 7

- Stress that raw data can be interpreted in many ways.

- Have students practice writing tally symbols in groups.

- Use Teacher Supplement 1 to give students practice in writing tally symbols.

- Have students complete Assignment Sheet 2. Use Teacher Supplement 2 to provide tree diameters and heights.

- Invite a forester to analyze their tally sheets or other tally sheets, describe the plot according to the tally and make recommendations for forest management.

APPLICATION

Objective 8

- Use Assignment Sheet 1 to teach students to recognize merchantable parts of trees and to determine merchantable height.

Objective 9

- Use Assignment Sheet 2 to teach students how to complete a tally sheet.

- Discuss using tally sheets to count items students are already familiar with such as livestock, crops, store or shop inventory, etc.

Objective 10

- Use Assignment Sheet 3 with Supplement 1 to give students math application and practical experience with the Doyle Log Rule and weight tables. Check their work and assign additional work, if needed, using the tally sheet from Assignment Sheet 2.

Objective 11

- Use Job Sheets 1 through 4 to give students the opportunity to learn the skills in this unit. Allow them plenty of practice in groups or alone to learn how to take tree measurements.

- Worksheets to complete the Practical Test are given at the end of each Practical Test. Photocopy the worksheets for students to use while taking the Practical Tests.

EVALUATION

Practical test

- Explain to students that they will be asked to demonstrate procedures on the job sheets to complete the practical test.

- Describe the rating scale used on the practical test.

- Give practical test.

- Reteach and retest as necessary.

Written test

- Explain to students that they will be asked to demonstrate on the written test actions listed in the specific objectives.
- Give written test.

  NOTE: The written test may be given in sections if desired.
- Evaluate students on assignment sheet activities if not previously done.
- Reteach and retest if necessary.
- Complete appropriate section of competency profiles.
- Review individual and group performance in order to evaluate teaching methods. Adjust scope, sequence, or instructional approaches for additional lessons as required.

SUGGESTED RESOURCES

Audiovisual Materials

- *Timber Cruising*, slide/script set. A series of 90 color slides and illustrated script explaining the basic terms and skills involved in timber cruising. The various measurements possible with a cruiser's stick are listed and illustrated. Problems involved in accurate measurements are shown, and their resolutions suggested. Designed for those wishing to enter the timber industry or manage a wood lot. Ohio Agricultural Curriculum Materials Service, The Ohio State University, Columbus, Ohio, 1980.

  NOTE: The above slide/tape set is available to Oklahoma teachers on a free-loan basis from the Oklahoma Department of Vocational and Technical Education, Resource Center, ATTN: Instructional Media Specialist, 1500 West Seventh Avenue, Stillwater, OK 74074.

Speakers

Oklahoma Natural Resources Speakers Bureau sponsored through Oklahoma State University, Division of Agriculture, Oklahoma Cooperative Extension Service - Forestry, Oklahoma Conservation Commission and the Oklahoma Forestry Association. Lists speakers on a variety of forestry-related topics. Speakers operate on a time-available basis. Request a listing of speakers, programs, slide presentations and videotapes from your local extension office or from:

Dr. Steve Anderson
Forestry Dept.
Oklahoma State University
239 Agriculture Hall
Stillwater, OK 74078
(405) 744-9431

Dave Marcouiller
Forestry Dept.
Oklahoma State University
242 Agriculture Hall
Stillwater, OK 74078
(405) 744-5444

Teachers from outside of Oklahoma should contact the Forestry Extension Office in their state.

UNIT REFERENCES

- Anderson, David A. and I. I. Holland, *Forests and Forestry*, The Interstate Printers & Publishers, Inc., Danville, Illinois, 1982.
- Bratkovich, Stephen M., *Measuring Woodland Timber*, OSU Extension Fact Sheet No. 5021, Oklahoma State University, Stillwater, Oklahoma, n.d.
- Collins, B. McManus, and Fred M. White, *Elementary Forestry*, Reston Publishing Company, Reston, Virginia, 1981.
- *Forestry Aide Curriculum for Native Americans*, Arizona Center for Vocational Education, Flagstaff, Arizona, 1984.
- *Harvesting Forestry Products*, Texas A & M University, College Station, Texas, 1976.
- Maeglin, Robert R., *Increment Cores: How to Collect, Handle, and Use Them*, U.S. Department of Agriculture, Forest Service, 1979.
- Stoddard, Charles H. and Glenn M. Stoddard, *Essentials of Forestry Practice*, 4th ed., John Wiley & Sons, New York, 1987.

PRACTICE ROUND FOR TALLY SYMBOLS

	DBH	Height
1.	6 in	16 ft
2.	14 in	2 1/2 logs
3.	4 in	16 ft
4.	4 in	16 ft
5.	10 in	2 logs
6.	4 in	16 ft
7.	4 in	16 ft
8.	8 in	20 ft
9.	4 in	16 ft
10.	8 in	18 ft
11.	14 in	2 logs
12.	4 in	12 ft
13.	4 in	14 in
14.	14 in	2 1/2 logs
15.	12 in	2 logs
16.	12 in	1 log
17.	12 in	1 1/2 log
18.	16 in	2 1/2 log
19.	10 in	2 logs
20.	10 in	2 logs
21.	24 in	4 logs
22.	4 in	14 ft
23.	12 in	2 logs
24.	5 in	12 ft
25.	5 in	10 ft

TREE MEASUREMENTS FOR ASSIGNMENT SHEET 2

	DBH	Height
1.	10 in	2 logs
2.	3 in	8 ft
3.	16 in	2 logs
4.	5 in	12 ft
5.	5 in	10 ft
6.	6 in	16 ft
7.	14 in	2 1/2 logs
8.	10 in	1 1/2 logs
9.	4 in	16 ft
10.	4 in	16 ft
11.	4 in	16 ft
12.	10 in	2 logs
13.	10 in	1 1/2 logs
14.	6 in	16 ft
15.	10 in	1 1/2 logs
16.	10 in	1 1/2 logs
17.	10 in	1 1/2 logs
18.	18 in	3 logs, deformed
19.	4 in	16 ft
20.	4 in	16 ft
21.	8 in	20 ft
22.	4 in	14 ft
23.	4 in	16 ft
24.	4 in	16 ft

	DBH	Height
25.	12 in	1 log
26.	12 in	1 1/2 log
27.	6 in	14 ft
28.	4 in	16 ft
29.	8 in	18 ft
30.	14 in	2 logs
31.	4 in	12 ft
32.	12 in	2 logs
33.	12 in	2 logs
34.	12 in	2 logs
35.	12 in	2 logs
36.	6 in	14 ft
37.	4 in	14 ft
38.	4 in	14 ft
39.	4 in	14 ft
40.	4 in	14 ft
41.	14 in	2 1/2 logs
42.	12 in	2 logs
43.	4 in	14 ft
44.	4 in	14 ft
45.	12 in	2 logs
46.	10 in	1 1/2 logs
47.	10 in	1 1/2 logs
48.	4 in	14 ft
49.	4 in	14 ft
50.	6 in	16 ft
51.	6 in	16 ft
52.	14 in	2 1/2 logs
53.	14 in	2 logs, deformed

	DBH	Height
54.	20 in	4 logs
55.	6 in	16 ft
56.	10 in	2 logs
57.	10 in	2 logs
58.	20 in	4 logs
59.	10 in	2 logs
60.	18 in	3 logs

TAKING A CORE SAMPLE USING AN INCREMENT BORER

If you don't already know how to use an increment borer, have a forester instruct you or check you on the following procedures.

You or the forester could demonstrate the use of the borer in an activity such as drilling a utility pole and checking the depth of treatment.

INTRODUCTION

The increment borer takes a small core sample of the interior wood. The sample will reveal information about the age of the tree, the growth rate, and growing conditions. This data indicates where and when trees should be cut and where they should be planted.

The borer is a hollow tube gradually twisted into the trunk with an auger bit. As the auger forces the tube into the center, it cuts a core of wood. The core is then removed with an extractor and the bark thickness and growth rings are clearly visible.

Parts Of The Increment Borer

Casing (used as a crank when assembled)
Main auger section
Extractor

NOTE: Increment borer bit starters are available to help force the bit into the tree.

TOOLS AND MATERIALS

- Increment borer
- Flagging
- Pencil
- Rag
- Spray lubricant
- Compass with ruler or ruler

PROCEDURE

1. Check that the bit end is well sharpened.

   NOTE: If the bit is not sharp it will break, especially on larger trees.

2. Open the casing and separate parts: auger and extractor.
3. Fit the crank onto the auger and drop the latch into place.
4. Place the main auger section against the side of the tree at 4 1/2 feet from the ground.
5. Hold the threaded bit with one hand, just above the thread, and apply pressure to the borer.
6. Turn the crank handle clockwise, drilling into the tree.

   CAUTION: Avoid "corkscrewing" of the outside end of the core. Work slowly and carefully, holding the threaded end so that the borer shaft will not waver from side to side or up and down while turning. Once the complete threaded bit is in the wood, both hands may be used to turn the borer.

7. Continue to drill until resistance is strong and the auger makes a noise.

   CAUTION: ***Do not push past the point of resistance and noise.***

8. Hold the extractor with the groove and the teeth facing *downward.*
9. Carefully insert the extractor straight into the auger without jamming it into the wood.

   CAUTION: Avoid turning the extractor. If it won't insert, slight rotation may be needed. Keep the rotation to a minimum.

10. Turn the crank in reverse (counterclockwise) 1/2 turn until the extractor groove is facing upward.
11. Remove the extractor carefully, being careful not to drop the core.
12. Hand the extractor to someone or set it on the ground.
13. Remove the auger immediately.

    CAUTION: If the borer is left too long in the tree, it will seize in place and be impossible to remove.

14. You may leave the core in the extractor or remove it by turning the extractor so the groove is facing downward; tap the tip gently to dislodge the core.

    WARNING: If the borer is broken off in the tree, the tree should be cut down. Metal left in a tree is a hazard in milling because the sawteeth can shatter, causing serious injury.

15. Spray the extractor with lubricant and wipe with a rag.

16. Put extractor and auger back in borer casing.

DETERMINE THE LAST FIVE AND TEN YEAR'S GROWTH RATE FROM A CORE SAMPLE

1. Count the first five rings from the outside end and mark with a pencil.
2. Measure with ruler.
3. Divide by five to find average growth rate for the last five years.

Length____________ Average growth rate ____________

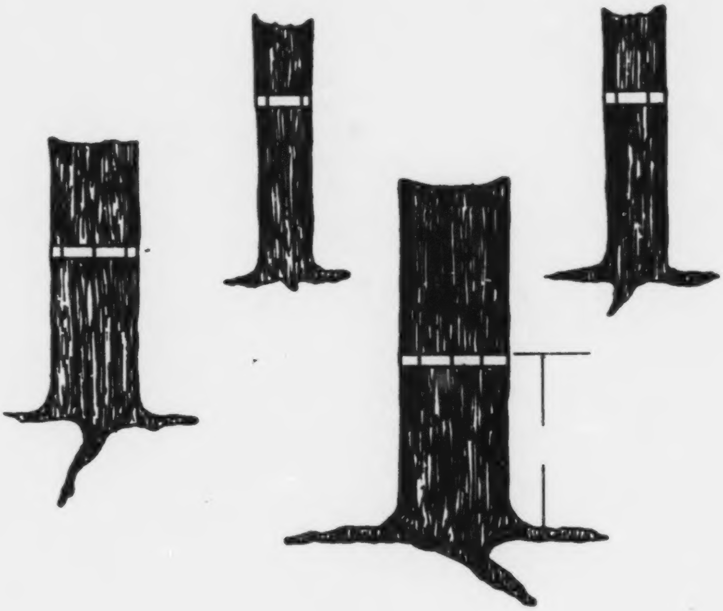
4. Repeat with the first ten rings to find the average growth rate for the last ten years.

Length ____________ Average growth rate____________

OBJECTIVE 1

Match terms associated with tree measurements to their correct definitions.

- **Basal area**—The cross-sectional area of trees at stump height, expressed in square feet per acre; used to determine volume



Basal Area

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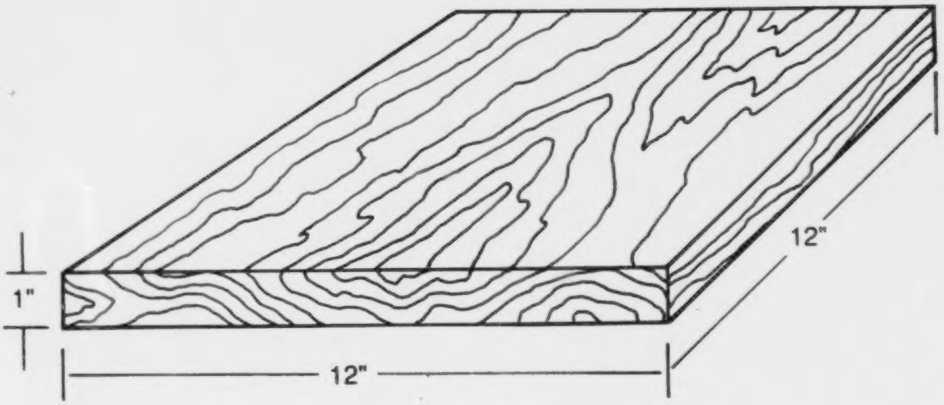
- **Board foot**—A unit of wood 1 x 12 x 12 inches, used in volume measurements

  NOTE: Board foot is abbreviated bd ft, bd/ft, or b/ft.



Board Foot

- **Bole**—The tree trunk or stem
- **Circumference**—Distance around the outside of the tree
- **Cord**—A measurement of stacked wood piled four feet high, four feet wide, and eight feet long; occupying 128 gross cubic feet of space (wood and air spaces between pieces of wood) and 80 cubic feet of solid wood
- **Cull**—A tree or log of merchantable size that is unmerchantable because of poor form, too many limbs, rot, or other defect, or an undesirable species
- **Cunit**—The equivalent of 100 cubic feet of wood
- **DBH** (Diameter Breast High)—Diameter measured at 4 1/2 feet from the ground
- **Dendrometer (den-drahm-i-ter)**—A collective term for all instruments used for measuring diameter
- **Diameter**—Distance through the center of the tree
- **DIB**—Diameter inside the bark

- **DOB**—Diameter outside the bark
- **Form class**—The taper of a tree trunk; expressed as a percentage ratio of the DOB at breast height and the DIB at the top of the first 16-foot log

  NOTE: 78 is an average form class for second-growth softwood and may reach 84 for old-growth softwood. The form class for hardwoods ranges between 70 and 80.

  EXAMPLE: A tree is 15 inches DBH and 12 inches DIB at the top of the first 16-foot log, measured at 17 feet—a 16-foot log and a 1-foot stump. The formula is:

$$\text{Form class} = \frac{\text{DIB} \times 100}{\text{DBH}}$$

$$= \frac{12 \times 100}{15} = 80\% \text{ or } 80 \text{ form class}$$

- **Hypsometer (hip-sahm-i-ter)**—A collective term for all instruments used for measuring height
- **MBF**—Thousand board feet

  NOTE: The "M" stands for *Mil*, short for the Latin word millesimum, meaning "thousandth."

- **Merchantable height**—Height suitable for marketing and utilization according to specifications of an organization or industry
- **Salvable**—Can be saved or salvaged
- **Sawlog**—A usable length of timber
- **Sawtimber**—Trees that yield lengths suitable in size and quality for the production of lumber

  NOTE: Softwoods are measured in 2-foot lengths and hardwoods are measured in 1-foot lengths

  EXAMPLE: Softwoods: 8 ft, 12 ft, 14 ft, 16 ft, 32 ft, depending on the location and use of the wood. Hardwoods: 8 ft, 9 ft, 10 ft. "Logs" are lengths of 8-foot sections. In southern forests a sawlog is generally 16 ft long; in Northwestern forests, a sawlog is 32 ft.

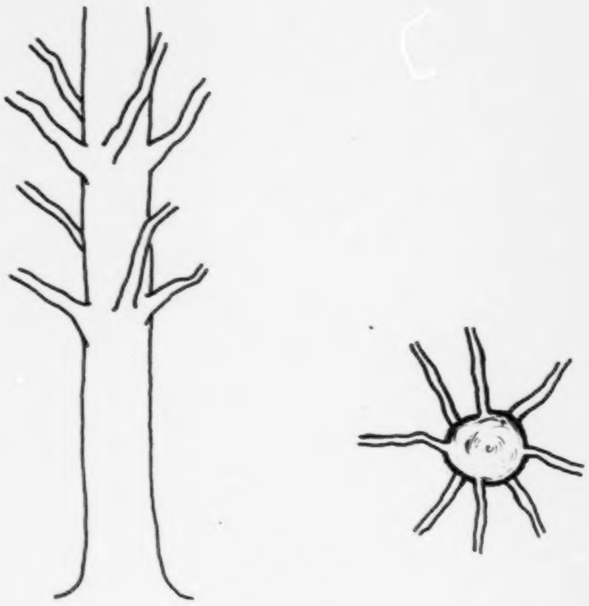
- **Sticks**—Lengths of pulpwood

  NOTE: "Sticks" are contrasted with "logs," used to describe sawlogs. Stick lengths will vary according to the contract specifications.

- **Taper**—The gradual reduction in stem diameter from the base to the top

- **Whorl**—The arrangement of several branches growing from a single stem

  NOTE: Whorls are found primarily on conifers.



Whorl

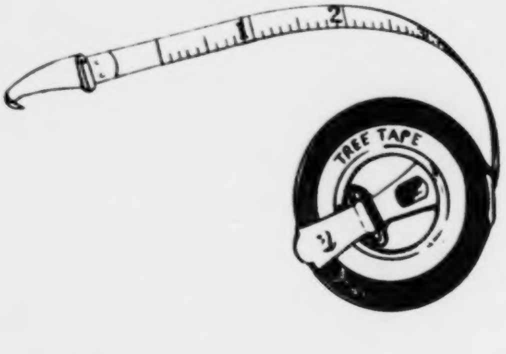
OBJECTIVE 2

Name tools used in taking tree measurements.

NOTE: *Dendro* and *dendri* are Greek for tree. *Hypso* and *hypsi* are Greek for height.

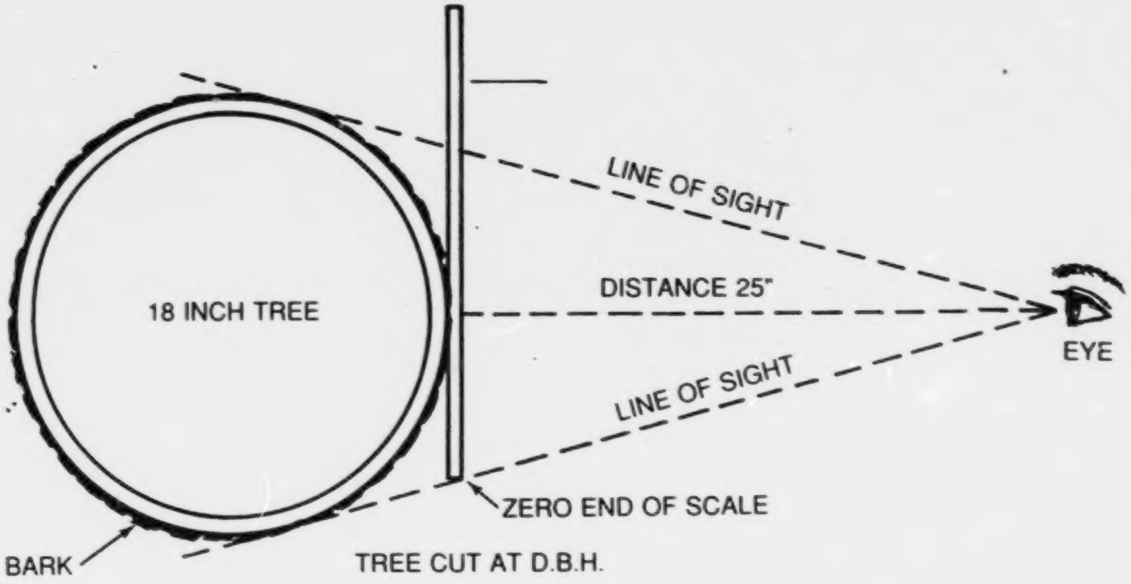
Dendrometers

- **Diameter tape**—Measures circumference and automatically converts it to diameter. The diameter tape has two measures, one on each side. On the diameter side, each "inch" is actually 3.1416 inches, or pi (π). The reading on the tape is the actual diameter. On the other side of the tape is a straight measure in inches and feet to determine Breast Height - 4 1/2 feet from ground level. The diameter tape is the most accurate dendrometer.



Diameter Tape

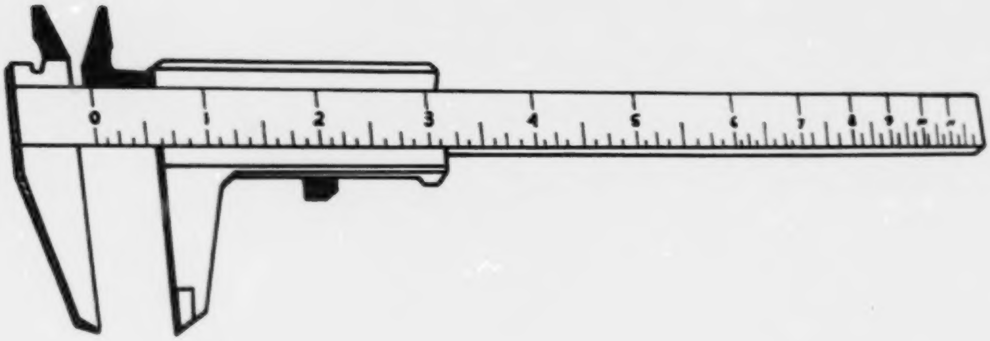
- **Biltmore stick**—Measurement is based on the geometric principle of similar triangles; the scale is graduated to read directly in inches. The stick is held against the tree at breast height and 25 inches from the eye. Also called a "cruiser stick," the Biltmore has this information on it:
  - A hypsometer scale to measure height in the number of 16-foot logs
  - A log rule to determine volume, given the height and DBH
  - Board foot volumes


LINE OF SIGHT
18 INCH TREE
DISTANCE 25"
EYE
LINE OF SIGHT
ZERO END OF SCALE
BARK
TREE CUT AT D.B.H.

Measuring A Tree's Diameter

- **Calipers**—A graduated rule with two arms, one fixed at a right angle to one end of the rule, the other sliding parallel to the fixed arm. DOB measurement is made by setting the fixed arm against the tree and moving the sliding arm against the other side. Diameter is read directly from the scale.

  NOTE: Two or more caliper readings are taken at right angles and then averaged to find the accurate diameter.

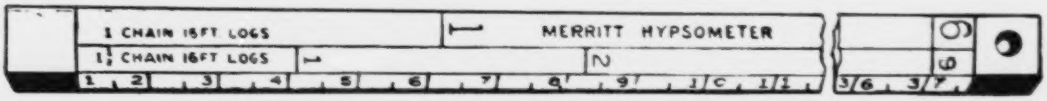


Calipers

Hypsometers

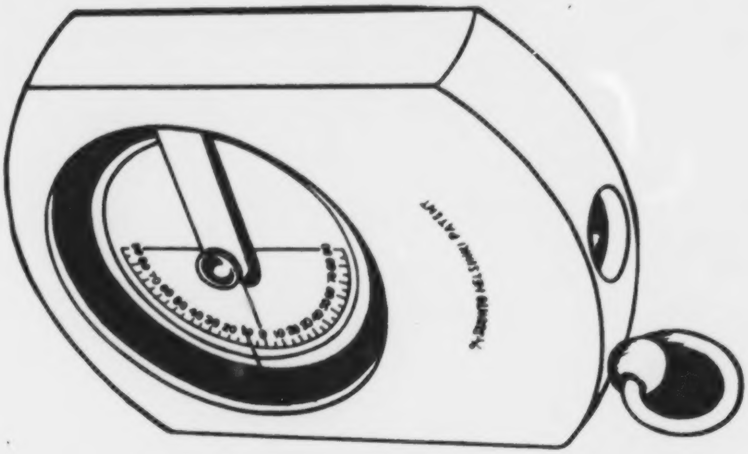
All hypsometers involve moving a certain distance from the tree and sighting through an instrument to measure the tree (1) from eye level to a point near the top where the diameter is the smallest usable timber; and (2) from eye level to the stump height. The two distances are combined to get the total height.

- **Merritt hypsometer**—On the narrow edge of the Biltmore stick; graduated in log lengths, usually 16 feet; measures to a height of 144 ft. Read at a distance of 1 chain (66 ft).



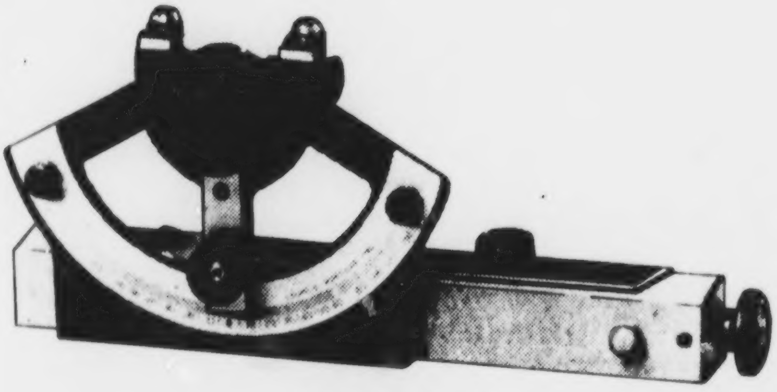
Merritt Hypsometer On Biltmore Cruiser Stick

- **Suunto (SUN-toe) clinometer**—Pocket-sized instrument with a percent scale for measuring slope and a degree scale for measuring vertical distances. The clinometer is the most common method of measuring height.



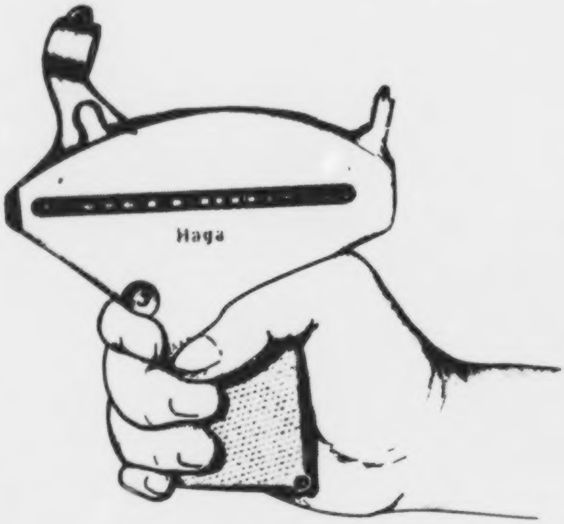
Suunto Clinometer

- **Abney hand level**—Lining up the tree top with the bubble and cross-hair gives a direct reading at a distance of 100 ft with the percent scale or at a distance of 1 chain (66 ft) with the topographic scale.



Abney Hand Level

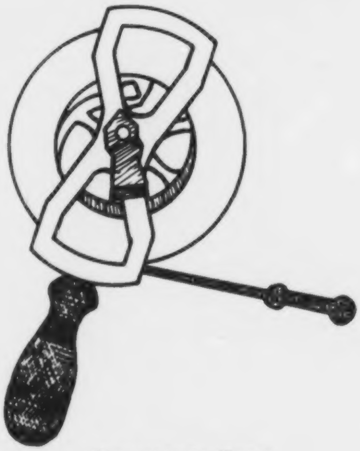
- **Haga altimeter**—Can measure heights and slopes on any of six scales according to the baseline distance from the tree; has a trigger to "point and shoot," locking the reading on the scale. If you use the "15" scale, you will get an accurate height reading at 15 ft, 15 yd, or 15 m. The Haga gives the most accurate readings of all measuring tools.



Haga Altimeter

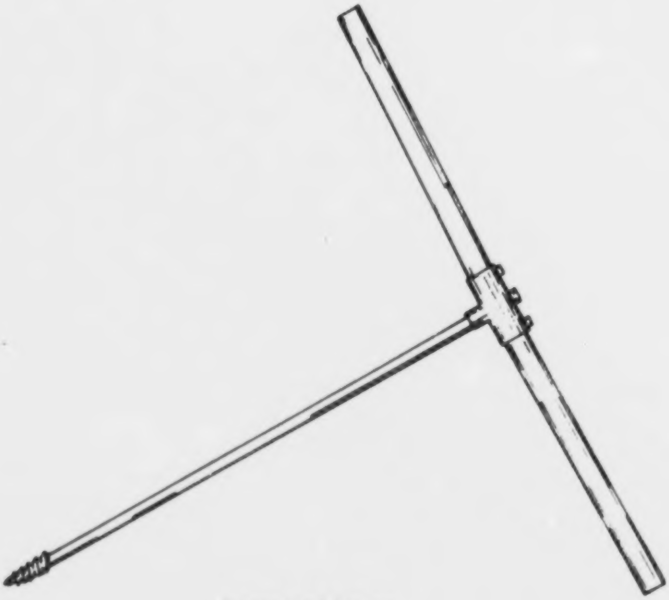
Other tools

- **Surveyor's tape**—Made from steel, fiberglass, or rope; measures distance from a tree to be measured.



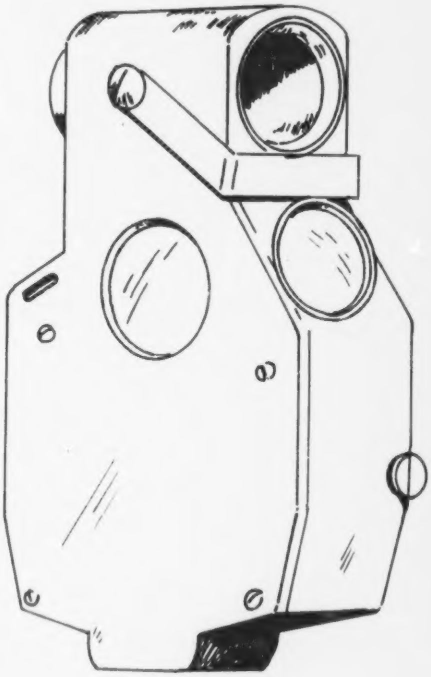
Surveyor's Tape

- **Increment borer**—Removes a core of wood from trees and logs; used to determine growth rate, age, and tree soundness. Also used to check chemical penetration in treated wood.



Increment Borer

- **Relaskop (REL-uh-scope)**—A sophisticated instrument that measures basal area, tree diameter, tree height, vertical angle, slope, and range (distance); and provides slope correction, form class and form height.



Relaskop

OBJECTIVE 3

Classify DBH measurements into the correct diameter classes.

Most measurements are made in the 2-inch class. The 1-inch class is used less frequently, such as when a more exact count is needed or for a specific purpose.

- **Two-inch class**
  9.0 in - 10.9 in = 10 in
  11.0 in - 12.9 in = 12 in
  13.0 in - 14.9 in = 14 in
  and so on

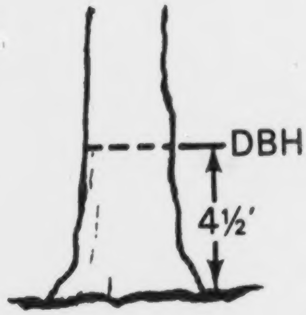
- **One-inch class**
  4.6 in - 5.5 in = 5 in
  5.6 in - 6.5 in = 6 in
  6.6 in - 7.5 in = 7 in
  7.6 in - 8.5 in = 8 in
  and so on

OBJECTIVE 4

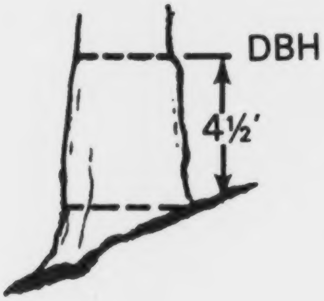
Determine the correct location of DBH measurements.

DBH is 4 1/2 feet from the ground. But a quick glance at the trees below shows that trees are not always on level ground and the DBH is not the same at all points on the circumference. A tree trunk tapers gradually from bottom to top. The taper is greater in hardwood than in softwood trees. When the tree is not on level ground, the DBH will be smaller on the uphill side because of the taper. So the DBH is always read on the uphill side, the shorter side having the smaller diameter.

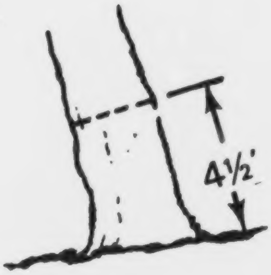
- **Tree on level ground**—Measure 4 1/2 ft from the ground.



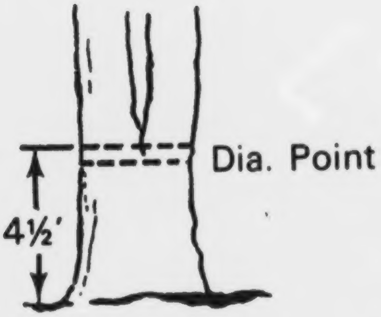
- **Tree on slope**—Measure 4 1/2 ft from the high side.



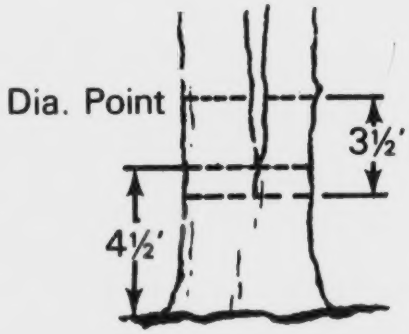
- **Leaning tree**—Measure 4 1/2 ft from the long, uphill side.



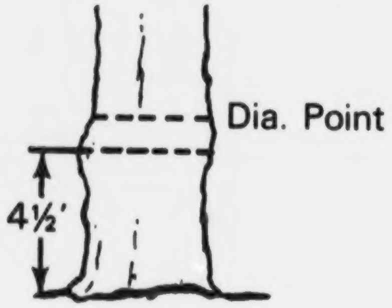
- **Tree forking at or above 4 1/2 ft**—Measure diameter below the swell (the tree will be thicker where it forks) and consider the tree as a single stem.



- **Tree forking below 4 1/2 ft**—Measure 4 1/2 ft from the ground if possible or measure the DBH above the swelling; consider the tree as two stems and measure both diameters.



- **Deformed tree**—Measure the normal stem closest to 4 1/2 ft, preferably above the deformation, but below it if necessary.



OBJECTIVE 5

Complete statements concerning merchantable height.

NOTE: These figures are *generally* true, and must be adjusted for specific location and use.

Sawtimber

- Merchantable height is determined by:

  In eastern and southern forests: The number of 16 ft logs and 8 ft half logs in a tree

  In western forests: 32 ft logs and 16 ft half logs

  In some hardwoods: 8 ft lengths

- Log lengths are usually recorded to the nearest half log.

  EXAMPLE: A sawtimber tree with a merchantable height of 39 ft would be tallied as 2 1/2 logs.

- Minimum DBH 10 inches or more, depending on how the timber will be used.

- Height is estimated to a point where the diameter of the tree trunk tapers to 8 in for pine and 10 in for hardwood.

Pulpwood

- Merchantable height is determined by the nearest pulpwood bolt of a given length, according to pulpmill specifications.

  EXAMPLE: 4 ft, 5 ft, 5 ft 3 in, depending on how the timber is to be used.

- A tree can be measured with bolts of mixed length.

  EXAMPLE: With a merchantable height of 24 ft, a tree is considered to have 6 bolts of 4 ft lengths or 5 bolts of 5 ft lengths.

- Minimum DBH is usually 4 in.

- Height is estimated to a point where the diameter of the tree trunk tapers to 4 in.

- In some instances the height of the total tree is used to measure pulpwood.

OBJECTIVE 6 **Distinguish among the major log scales.** (Supplement 1)

- For many years, all timber was valued (priced) by volume. The most popular measures were board feet, cubic feet, cunits and cords. Firewood is measured in cords and half-cords called ricks.

- Standards, called log rules or log scales, have been established to provide common guidelines for determining volume according to form class, DBH, and tree height. The volume is measured in board feet, as shown in the Doyle Log Scale in Supplement 1.

  EXAMPLE: In the Doyle Log Scale (commonly used in Oklahoma and other Southern Forest areas), timber with a DBH of 12 inches, 2 logs long, is considered to contain a volume of 43 board feet.

The scale is read across from the DBH to the number of logs in the stem.

Number of 16-foot logs

DBH	1	1 1/2	2	2 1/2	3	3 1/2	4
10	14	17	20	21	22		
11	22	27	32	35	38		
12	29	36	43	48	53	54	56
13	38	48	59	66	73	76	80

- In recent years, weight has become a common measure for buying and selling most bulk products. A weight table showing merchantable green weight of loblolly and shortleaf pine stems is included in Supplement 1.

- Over 50 different log rules are used in the United States. The most common rules are:

  - Doyle log rule

  - Scribner log rule

  - International log rule

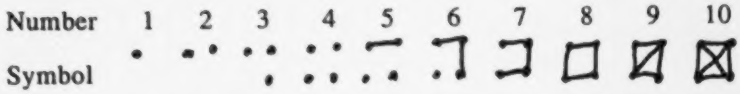
OBJECTIVE 7

Draw tally symbols.

The tally is the actual count of tree diameter and height. The written record is kept on a tally sheet. Usually, one person measures and counts and a second person keeps the tally. Tally sheets will vary according to their purposes and the personal preference of the foresters using them.

The tally sheet will provide a chart for recording diameter and height as in the example on page 38.

The symbols are standardized in a dot-dash system, so that everyone can recognize and read them. They allow the tallier to make a fast, accurate count in a small space. The tally code can be used to count any item, such as livestock or produce.



Here's how it works:

1. Moving clockwise, a dot is made for each tree up to 4 trees, forming a box.
2. Moving in the same direction, the 4 dots are connected with straight lines up to 8 trees.
3. The 9th tree is represented by a diagonal line.
4. The 10th tree is represented by a diagonal in the opposite direction.

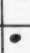
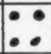
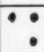
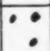
EXAMPLE: Every time you count a tree, you write a dot or a line:

TALLY SHEET

Estimator: ____________ Plot No: ____________

Date: ____________ Size of Plot: ____________

Owner: ____________

Diameter Breast Height (inches)	Number of 16-ft. logs															
	Spruce				Oak				Pine				Fir			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
10																
12																
14																
16																

- When you are finished counting, you get the volumes from the log rule and multiply by the number of trees of each DBH and log length to find the total volume.

  EXAMPLE: There are four stems with a DBH of 12 inches and 2 logs long.
  43 x 4 = 172

  Find the total volume for the trees in the tally sheet on page 38, using the Doyle Rule in Supplement 1. Correct answers are on page 40.

  Volume ________

  If this timber sells for $110 MBF, how much is it worth?

  ____

Volume = 1081 bd ft, Value = $118.91

VOLUME AND WEIGHT TABLES

Standing Tree Board Foot Volumes for Sawtimber in Eastern Oklahoma (Doyle Rule)

	Number Of 16-foot Logs						
DBH (inches)	1	1 1/2	2	2 1/2	3	3 1/2	4
10	14	17	20	21	22	-	-
11	22	27	32	35	38		
12	29	36	43	48	53	54	56
13	38	48	59	66	73	76	80
14	48	62	75	84	93	98	103
15	60	78	96	108	121	128	136
16	72	94	116	132	149	160	170
17	86	113	140	161	182	196	209
18	100	132	164	190	215	232	248
19	118	156	194	225	256	276	297
20	135	180	225	261	297	322	346
21	154	207	260	302	344	374	404
22	174	234	295	344	392	427	462
23	195	264	332	388	444	483	522
24	216	293	370	433	496	539	582
25	241	328	414	486	558	609	660
26	266	362	459	539	619	678	737
27	292	398	505	594	684	749	814
28	317	434	551	650	750	820	890
29	346	475	604	714	824	902	980
30	376	517	658	778	898	984	1,069

C00

Firewood Cord Volumes In Hardwood Trees

	Tree Height (feet) to a 4-inch Top								
DBH (Inches)	10	20	30	40	50	60	70	80	90
6	.02	.03	.05	.06	.07	.09	-	-	-
8	.03	.05	.08	.10	.12	.14	.16	.19	-
10	-	.08	.12	.15	.18	.21	.25	.28	.31
12	-	-	.17	.22	.27	.32	.37	.42	.47
14	-	-	.22	.29	.36	.43	.50	.56	.63
16	-	-	-	.38	.46	.55	.64	.73	.81
18	-	-	-	.47	.58	.69	.80	.91	1.02
20	-	-	-	.58	.71	.84	.98	1.11	1.24
22	-	-	-	.69	.85	1.01	1.17	1.33	1.49
24	-	-	-	.81	1.00	1.20	1.38	1.57	1.76

Merchantable Green Weight of Loblolly and Shortleaf Pine Stems

	1 Log Tree	2 Log Tree	3 Log Tree	4 Log Tree
DBH (inches)	TONS			
10	0.16	0.35	0.48	-
12	0.21	0.48	0.69	-
14	0.28	0.65	0.93	1.15
16	-	0.83	1.19	1.54
18	-	1.05	1.51	1.95
20	-	1.30	1.78	2.38

MEASURING HEIGHTS WITH A SUUNTO CLINOMETER

3 steps:

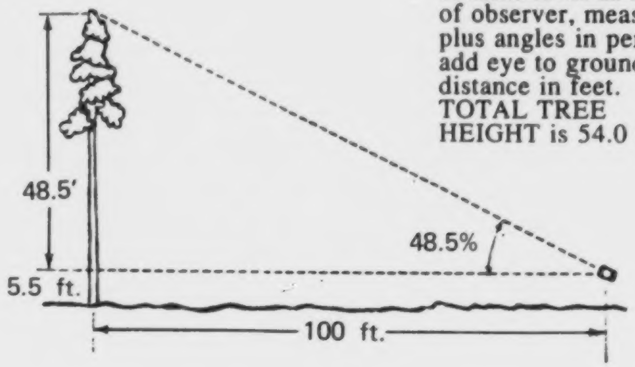
(1) Take a reading at the top of the tree.

(2) Take a reading at the bottom of the tree.

(3) Calculate the height.

- **When the tree is on the same level as the observer:**

1. Top reading is a + value
   Bottom reading is a - value
2. Add for total height

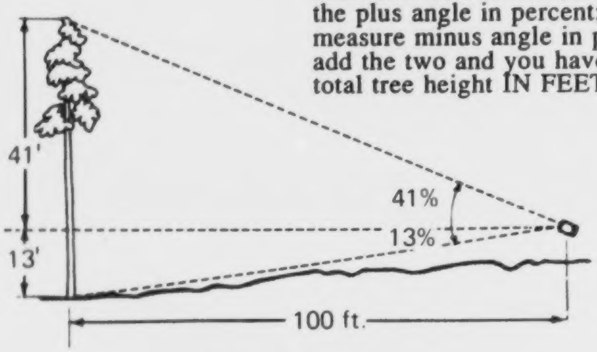


When base of tree is at same level as feet of observer, measure plus angles in percent, add eye to ground distance in feet. TOTAL TREE HEIGHT is 54.0 feet.

Tree Same Level As Observer

- **When the tree is below the observer:**

  1. Top reading is a + value
     Bottom reading is a - value
  2. Add for total height

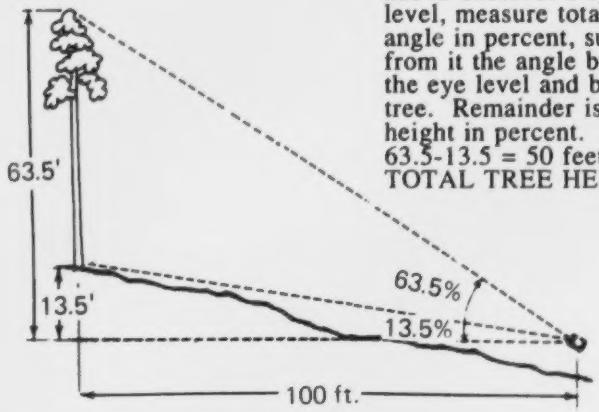


When base of tree is below the foot level of observer, measure the plus angle in percent; measure minus angle in percent, add the two and you have the total tree height IN FEET.

Tree Below Observer

- **When the tree is above the observer:**

  1. Top reading has a + value
     Bottom reading has a + value
  2. Subtract bottom reading from the top reading



When the base of tree is above observer's eye level, measure total plus angle in percent, subtract from it the angle between the eye level and base of tree. Remainder is tree height in percent.
63.5-13.5 = 50 feet
TOTAL TREE HEIGHT.

Tree Above Observer

ASSIGNMENT SHEET 1

PRACTICE TREE MEASUREMENT

IX

NAME ______________________________ SCORE _______

OBJECTIVE 8

Determine merchantable height of trees.

INTRODUCTION

One of the objectives of good forestry practices is to use the whole tree. Merchantable height depends on the tree species and what the timber will be used for. It is measured to a point on the trunk where the diameter is too small to obtain a particular product. As you would expect, sawlogs have the greatest value.

Most private-forest landowners hire consultants to determine merchantable height in order to estimate the value and yield.

The U. S. Forest Service classifies sawlog height according to these points:

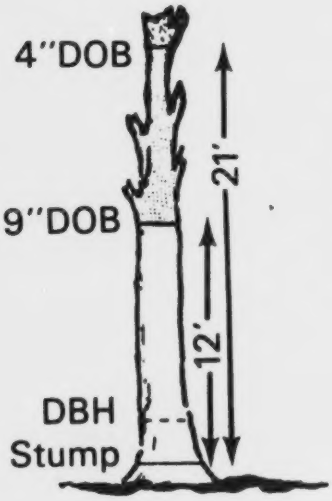
- The length is recorded to the last whole foot of the bole of all sawtimber-size live and salvable dead trees:
  - Softwoods 9.0 inches DBH and larger
  - Hardwoods 11.0 inches DBH and larger
- From a 1-foot stump to the point above which no sawlog can be produced to meet log grade standards, or to a minimum top of:
  - 7.0 inches DOB for softwoods
  - 9.0 inches DOB for hardwoods
- A sawlog should not extend above a point where taper becomes excessive, as evidenced by:
  - A fork with less than an 8-foot sawlog above it (12 feet if this is the only log in the tree).
  - A limb with a base diameter equal to one-half or more of the stem diameter below the limb, or a group of smaller limbs with equivalent diameter which collectively influence taper to the same degree.

- Sawlog length should not extend above a sawlog section that does not meet minimum log grade specifications and which has less than 8 feet of sawlog length above it.

DIRECTIONS

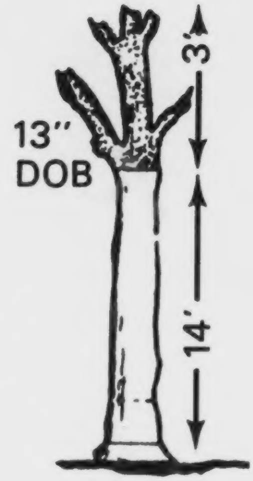
Review the classifications above. Look at the trees on the following pages and determine their merchantable height. Write the correct heights in the blanks.

EXAMPLE:



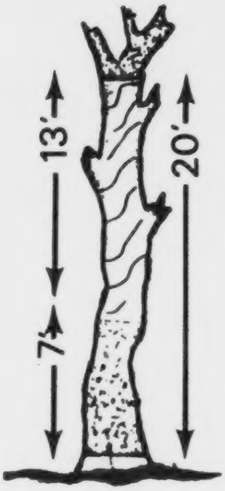
A sawtimber tree. Sawlog length terminates at 9-inch top DOB. Meets minimum qualifications of a 12-foot sawlog since it's the only log in the tree. Upper stem portion contains no cull and terminates at 4 inches DOB. Bole length is 21 feet.

MH 12 ft



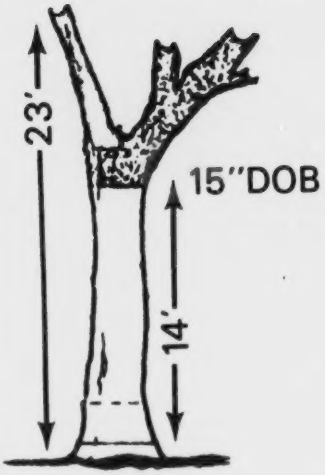
A sawtimber tree. Sawlog portion terminated by limbs at 13 inches DOB. Contains no cull and meets minimum grade specifications. Portion between whorls of limbs is large enough in diameter but not in length to qualify as an upper stem, such as less than 4 feet long. Bole length 14 ft.

1. MH ____________



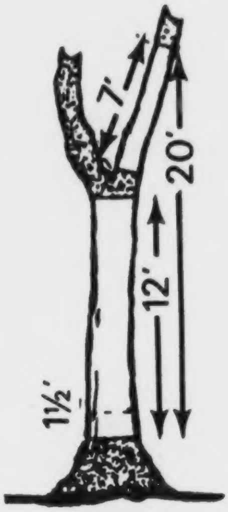
A rotten cull tree. Although sawlog portion is 20 feet long, a 13-foot section of rotten cull prevents utilization of a log meeting minimum grade specifications; thus the whole sawlog portion is culled. Because more than half the volume in that portion is rotten, the tree is classed as a rotten cull tree.

2. MH ____________



A sawtimber tree. Sawlog portion terminated because of branching at 15-inch top DOB meets minimum specifications. The right-hand fork is too limby to qualify as upper stem, but 7 feet of the left-hand fork qualifies as an upper stem.

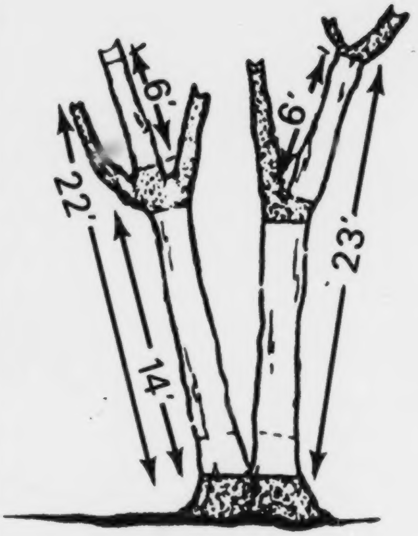
3. MH ____________



A sawtimber tree. A sound cull in the sawlog portion due to butt swell; 7 feet of the right-hand fork qualifies as an upper stem. Bole length is 20 feet.

4. MH ____________

G07



Two sawtimber trees. Since the lowest fork is below DBH, each fork is appraised and recorded as a separate tree. A 6 foot portion of the largest stem in the upper fork qualifies as upper stem material. Bole length is the same for both.

5. MH ____________

609

ASSIGNMENT SHEET 2

PRACTICE TREE MEASUREMENT

IX

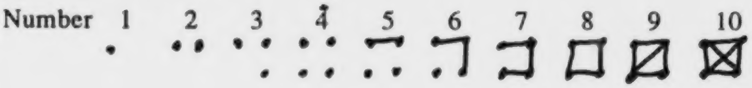
NAME ______________________________ SCORE ________

OBJECTIVE 9

Complete a tally sheet.

INTRODUCTION

Like a baseball scoreboard shows the runs and outs in each inning to make up the total score, the tally allows the forester to keep track of the diameters and heights of the trees measured in a tract of land. On a cruise the forester, or estimator, calls out the size of the tree and the tally keeper uses the dot-and-line code to record the calls.



In Unit 12 where you will be cruising timber stands, you will be working as both the estimator and the tally person. So learn this skill well—it could help you get a summer job working in forestry!

DIRECTIONS

Practice writing the code in the space provided. After you have had an opportunity to learn the code, your teacher will give you a "practice round" to get used to using the tally sheet.

The instructor will call out the tree diameter class and the height or number of logs. As the measurements are given, write the correct dots and dashes to record the tally.

TIPS

- For this assignment only (remember that a tally will be designed to meet specific requirements):

  There are two sections: Pulpwood and Sawtimber

  - If the DBH is under 10 in, the tree is considered pulpwood.
  - If the DBH is over 10 in, the tree is considered sawtimber.
- For all tallies:
  - Pulpwood lengths will be given in feet.
  - Sawtimber lengths will be given in logs and half logs.

Practice writing the code here:

1 2 3 4 5 6 7 8 9 10

Form No. 1001

Tract__________

Owner__________

Marker__________

Date__________

TIMBER MARKETING TALLY SHEET

FORESTRY DIVISION
STATE DEPARTMENT OF AGRICULTURE
122 CAPITOL BUILDING
OKLAHOMA CITY, OKLA. 73105

DATE	TOTAL TALLY

PULPWOOD

_____th TREE TALLY

		TOTAL MERCHANTABLE HT. — FEET																		
DIA.		6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42
2.5 TO 3.5	3																			
3.6 TO 4.5	4																			
4.6 TO 5.5	5																			
5.6 TO 6.5	6																			
6.6 TO 7.5	7																			
7.6 TO 8.5	8																			
8.6 TO 9.5	9																			

SAW TIMBER—100% Tally 16 Ft. Logs

Sound
Defective

										LARGE TREES		
DIA.		½ 8' – 12'	1 12' – 20'	1½ 21' – 27'	2 28' – 37'	2½ 38' – 45'	3 46' – 53'	3½ 54' – 60'	4 61' – 68'	DIA	HT	S D
9.0 – 10.9	10											
11.0 – 12.9	12											
13.0 – 14.9	14											
15.0 – 16.9	16											
17.0 – 18.9	18											
19.0 – 20.9	20											
21.0 – 22.9	22											
23.0 – 24.9	24											
25.0 – 26.9	26											
27.0 – 28.9	28											
29.0 – 30.9	30											

Gi1

Form No. 1001

Tract____________________

Owner____________________

Marker____________________

Date____________________

TIMBER MARKETING TALLY SHEET

FORESTRY DIVISION
STATE DEPARTMENT OF AGRICULTURE
122 CAPITOL BUILDING
OKLAHOMA CITY, OKLA. 73105

DATE	TOTAL TALLY

PULPWOOD

______th TREE TALLY

DIA.		TOTAL MERCHANTABLE HT. — FEET																		
		6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42
2.5 TO 3.5	3																			
3.6 TO 4.5	4																			
4.6 TO 5.5	5																			
5.6 TO 6.5	6																			
6.6 TO 7.5	7																			
7.6 TO 8.5	8																			
8.6 TO 9.5	9																			

SAW TIMBER—100% Tally 16 Ft. Logs

Sound Defective

DIA.		½ 8 - 12'	1 12' - 20'	1½ 21' - 27'	2 28' - 37'	2½ 38' - 45'	3 46' - 53'	3½ 54' - 60'	4 61' - 68'	LARGE TREES DIA	HT	S D
9.0 – 10.9	10											
11.0 – 12.9	12											
13.0 – 14.9	14											
15.0 – 16.9	16											
17.0 – 18.9	18											
19.0 – 20.9	20											
21.0 – 22.9	22											
23.0 – 24.9	24											
25.0 – 26.9	26											
27.0 – 28.9	28											
29.0 – 30.9	30											

612

ASSIGNMENT SHEET 3

PRACTICE TREE MEASUREMENT

NAME ______________________________ SCORE ________

OBJECTIVE 10

Calculate estimated volume, weight, and value of timber.

INTRODUCTION

Tree measurements are just data—items of information that don't have much meaning by themselves, like separate chemicals in a formula or clues in a puzzle. When the data is put together in a meaningful way, then you can draw conclusions about how much wood you have and how much value it has.

Using the volume and weight tables in Supplement 1, you can take the raw data and determine the volume or weight and the value of timber.

DIRECTIONS

PART 1

Using the log sizes on the following page and the Doyle Log Rule, complete the tally sheet and determine the volume of timber. Use the worksheet on page 57.

TALLY SHEET

State: OK County: LeFlore Owner: R. Smith

Section: 4 T. 3 R. 8 Forty_____ Estimator:__________ Plot No._____

DBH (inches)	Number of 16-ft. logs															No. of Trees	Total Vol.
	Loblolly Pine					Shortleaf Pine					Hardwoods						
	1	1 1/2	2	2 1/2	3	1	1 1/2	2	2 1/2	3	1	1 1/2	2	2 1/2	3		
10		━┓ •┛	• • • •				•				•						
12		━┓ ━┛	• • •				•				•						
14		•	•━• • •	• •								•					
16			• •	━┓ •┛	• •												
18				• • • •	• •												
20				• •	•												
22				•	•												
24																	
TOTAL VOLUME IN BOARD FEET																	

1. Total volume in bd ft. = _______

2. If the contract is for $112 per MBF, what is the value of this timber?

   _______ = Value of timber by volume in bd ft.

Worksheet For Calculating Total Volume

DBH (inches) 10		12		14		16	
Log Size # of Trees X Value	= Vol.	Log Size # of Trees X Value	= Vol.	Log Size # of Trees X Value	= Vol.	Log Size # of Trees X Value	= Vol.
1		1		1		1	
1 1/2		1 1/2		1 1/2		1 1/2	
2		2		2		2	
2 1/2		2 1/2		2 1/2		2 1/2	
3		3		3		3	
TOTAL		TOTAL		TOTAL		TOTAL	

DBH (inches) 18		20		22		24	
Log Size # of Trees X Value	= Vol.	Log Size # of Trees X Value	= Vol.	Log Size # of Trees X Value	= Vol.	Log Size # of Trees X Value	= Vol.
1		1		1		1	
1 1/2		1 1/2		1 1/2		1 1/2	
2		2		2		2	
2 1/2		2 1/2		2 1/2		2 1/2	
3		3		3		3	
TOTAL		TOTAL		TOTAL		TOTAL	

Worksheet For Calculating Total Weight

DBH (inches) 10		12		14		16	
Log Size # of Trees X Value	= Weight	Log Size # of Trees X Value	= Weight	Log Size # of Trees X Value	= Weight	Log Size # of Trees X Value	= Weight
1		1		1		1	
2		2		2		2	
3		3		3		3	
TOTAL		TOTAL		TOTAL		TOTAL	

DBH (inches) 18		20					
Log Size # of Trees X Value	= Weight	Log Size # of Trees X Value	= Weight				
1		1					
2		2					
3		3					
TOTAL		TOTAL		SUB TOTAL		TOTAL WEIGHT	

PART 2

Determine the weight for 1, 2, and 3 log loblolly pines up to 20 inches DBH. Use the worksheet on page 58.

1. _______ = Total weight of loblolly pine

2. If the contract is for $14 per ton, what is the value of the timber?

   _______ = Value of timber by the ton

ASSIGNMENT ANSWERS

PRACTICE TREE MEASUREMENT

IX

ASSIGNMENT SHEET 1

1. 14 ft
2. 0
3. 14 ft
4. 12 ft
5. 14 ft and 23 ft or 37 ft

ASSIGNMENT SHEET 2

See following page for answers.

Form No. 1001
Tract____________________
Owner____________________
Marker____________________
Date____________________

TIMBER MARKETING TALLY SHEET

FORESTRY DIVISION
STATE DEPARTMENT OF AGRICULTURE
122 CAPITOL BUILDING
OKLAHOMA CITY, OKLA. 73105

DATE	TOTAL TALLY

PULPWOOD

______th TREE TALLY

DIA.		6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42
		TOTAL MERCHANTABLE HT. — FEET																		
2.5 TO 3.5	3																			
3.6 TO 4.5	4				●	● ●	●—● ● ●													
4.6 TO 5.5	5			●	●															
5.6 TO 6.5	6						●													
6.6 TO 7.5	7																			
7.6 TO 8.5	8							●	● ●											
8.6 TO 9.5	9																			

SAW TIMBER—100% Tally 16 Ft. Logs

Sound / Defective

DIA.		½ 6' – 12'	1 12' – 20'	1½ 21' – 27'	2 28' – 37'	2½ 38' – 45	3 46' – 53'	3½ 54' – 60'	4 61' – 68'	LARGE TREES DIA	HT	S D
9.0 – 10.9	10				● ● ●							
11.0 – 12.9	12		●	●	● ●							
13.0 – 14.9	14				●	● ●						
15.0 – 16.9	16					●						
17.0 – 18.9	18											
19.0 – 20.9	20											
21.0 – 22.9	22											
23.0 – 24.9	24								●			
25.0 – 26.9	26											
27.0 – 28.9	28											
29.0 – 30.9	30											

619

Form No. 1001

Tract__________

Owner__________

Marker__________

Date__________

TIMBER MARKETING TALLY SHEET

FORESTRY DIVISION
STATE DEPARTMENT OF AGRICULTURE
122 CAPITOL BUILDING
OKLAHOMA CITY, OKLA. 73105

DATE	TOTAL TALLY

PULPWOOD

____th TREE TALLY

DIA.		TOTAL MERCHANTABLE HT. — FEET																		
		6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42
2.5 TO 3.5	3		•																	
3.6 TO 4.5	4				•	☒	☐													
4.6 TO 5.5	5			•	•															
5.6 TO 6.5	6					•	• • • •													
6.6 TO 7.5	7																			
7.6 TO 8.5	8							•	•											
8.6 TO 9.5	9																			

SAW TIMBER—100% Tally 16 Ft. Logs

Sound / Defective

LARGE TREES

DIA.		½ 8' – 12'	1 12' – 20'	1½ 21' – 27'	2 28' – 37'	2½ 38' – 45'	3 46' – 53'	3½ 54' – 60'	4 61' – 68'	DIA	HT	S D
9.0 – 10.9	10			⊐	‾ • •							
11.0 – 12.9	12		•	• •	⌝ •							
13.0 – 14.9	14				• •	• • •						
15.0 – 16.9	16				•							
17.0 – 18.9	18						• •					
19.0 – 20.9	20							•	• •			
21.0 – 22.9	22											
23.0 – 24.9	24											
25.0 – 26.9	26											
27.0 – 28.9	28											
29.0 – 30.9	30											

6[illegible]

ASSIGNMENT SHEET 3

PART 1

1. 6,129 bd ft
2. $686.448, can be rounded to $686.45

PART 2

1. 14.28 tons
2. $199.92

JOB SHEET 1

PRACTICE TREE MEASUREMENT

OBJECTIVE 11a

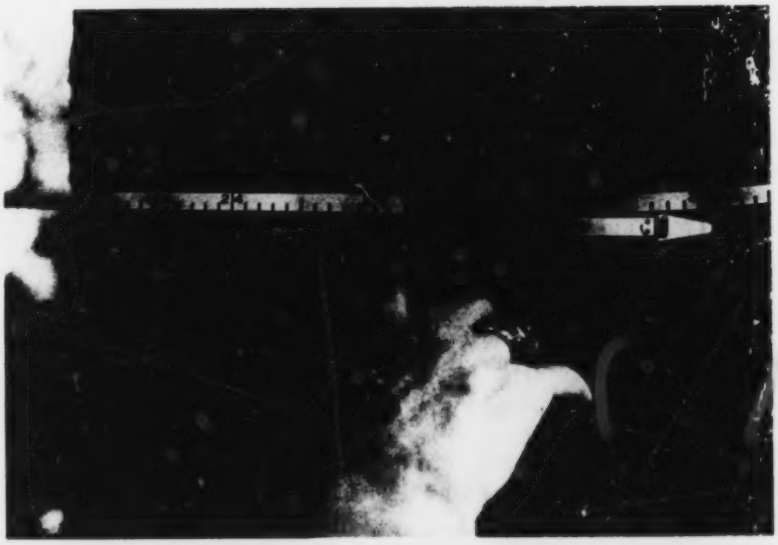
Measure diameter using a diameter tape.

TOOLS AND MATERIALS

- Diameter tape
- Selected trees
- Pencil and paper
- Clipboard

PROCEDURE

1. Measure 4 1/2 feet on the side of the tree.
2. Find this height on your body for DBH height reference.
3. Select the correct placement of the DBH measure. (See Objective 4 on the rules for correct measurement)
4. Turn the tape so the diameter measure is on the outside of the tape (away from you).
5. Extend the tape around the tree from the left side.
6. Grasp the hook end of the tape with the right hand.
7. Pull the tape taut with hands crossed over each other, left hand on top.



Reading a Diameter Tape

8. Read the tape at the point of intersection of '0' mark and diameter marks.

9. Record the DBH to the nearest 1/10 in of diameter.

10. Record class and DBH in the proper class.

Tree No.	DBH to 1/10 in	Class 1 in or 2 in	DBH
1.			

11. Have your instructor check your work.

NOTE: For the practical test you will measure and record the DBH for 10 trees.

JOB SHEET 2

PRACTICE TREE MEASUREMENT

IX

OBJECTIVE 11b

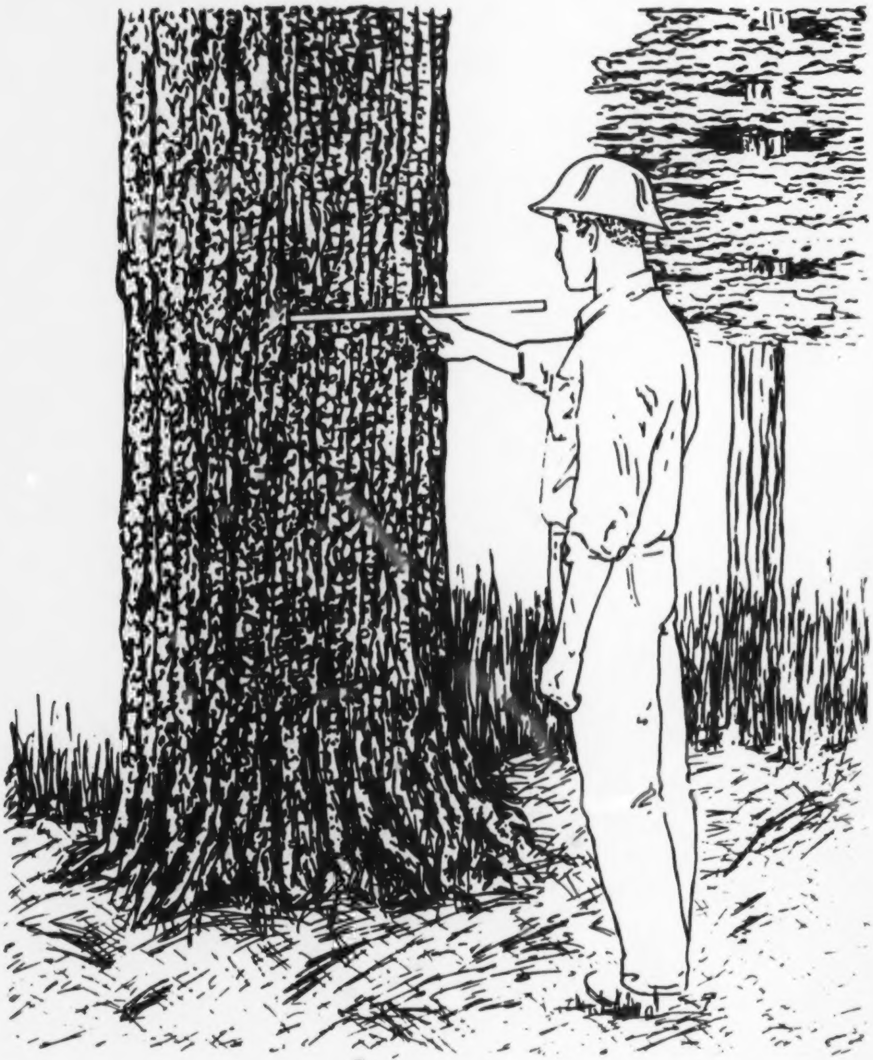
Measure diameter using a Biltmore stick.

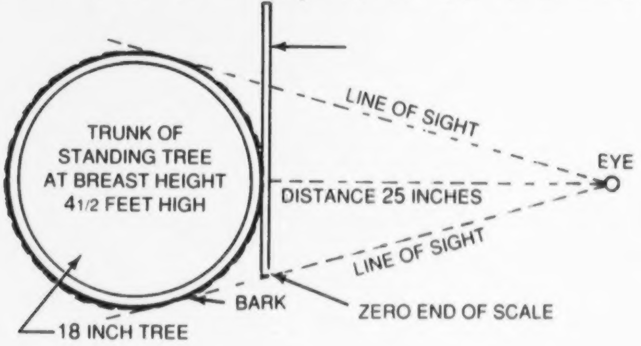
TOOLS AND MATERIALS

- Biltmore stick
- Selected trees
- Pencil and paper
- Clipboard
- Length of string, a little more than 25" long

PROCEDURE

1. Select the correct place to measure the DBH according to the rules for measurement.
2. Tie a string to a shirt button and trim it so that the end of the string is 25 inches from the body.
3. Hold the stick at about the midpoint with your thumb toward you.
4. Stand so that the stick is 25 in from the eye (string's length).
5. Place the stick horizontally against the tree at DBH with the left edge of the stick along one edge of the tree, hold it level with your thumb *outside* the bark. See the illustration on page 68.




LINE OF SIGHT
TRUNK OF STANDING TREE AT BREAST HEIGHT 4 1/2 FEET HIGH
EYE
DISTANCE 25 INCHES
LINE OF SIGHT
BARK
ZERO END OF SCALE
18 INCH TREE

Courtesy of Instructional Materials Service, Texas A&M University, College Station, Texas.

Check the following:

a. If the edge of the stick is inside the bark, the reading will be too small; if the edge of the stick is outside the bark, the reading will be too large.

b. If the thumb is inside the bark, the reading will be too small.

c. If the stick is not held level, the reading will be too large.

6. Close one eye.

7. Without moving your head, read the diameter along the stick.

8. Record the diameter.

Tree No.	DBH
1.	____________

9. Have your instructor check your work.

NOTE: For the practical test you will measure and record the DBH for 10 trees.

JOB SHEET 3

PRACTICE TREE MEASUREMENT

IX

OBJECTIVE 11c

Measure height using a Biltmore stick.

TOOLS AND MATERIALS

- Biltmore stick
- Selected trees
- Pencil and paper
- Clipboard
- Length of string, a little more than 25" long

PROCEDURE

1. Pace or measure a distance of 1 chain from the tree, at about the same elevation as the tree.
2. Tie a string to a shirt button and trim it so that the end of the string is 25 inches from the body.
3. Hold the stick vertically, with the Merritt hypsometer facing you, exactly 25 inches from the eye, at the end of the string.
4. Line up the bottom of the scale with the stump level, one foot above the ground.
5. *Without moving the head* (Move your eyes, not your head), read the number of logs on the scale at the point on the stick even with the top of the tree or at merchantable height:

   10 inches DOB for sawtimber, 8 inches for pine or softwood, or 4 inches for pulpwood.
6. Record your readings. Use 16-foot logs and 8-foot half-logs for sawtimber and height of tree in feet for pulpwood sticks in 4-foot multiples. Record only whole or half logs.

Tree No.	"S" Sawtimber "P" Pulpwood	No. of logs in total ht.	No. of logs in merchantable ht.
1.	____________	____________	____________

7. Have your instructor check your work.

   NOTE: For the practical test, you will measure 10 trees.

JOB SHEET 4 — PRACTICE TREE MEASUREMENT — IX

OBJECTIVE 11d

Measure merchantable height using a Suunto clinometer.

TOOLS AND MATERIALS

- Suunto clinometer
- 100 ft tape
- Selected trees
- Pencil and paper
- Clipboard
- Supplement 2

PROCEDURE

NOTE: Learn the information in Supplement 2 before taking the practical test.

1. Select the percent scale.
2. Measure a distance of 100 feet from the tree to a point where both top and bottom of the tree can be seen.

   NOTE: The percent scale can be used at any distance. The clinometer reads in percent of the baseline distance you select. Since this measurement is made 100 ft from the tree, the scale can be read directly. A 50 ft distance can be used by dividing the answer in half.
3. Estimate the point of top merchantability using these guidelines:

   NOTE: Height *must be* determined *before* using the clinometer.

   - Minimum top of 7.0 inches DOB
   - A fork with less than 8 feet in either fork
   - A limb with a diameter equal to 1/2 or more of the bole diameter at the point of occurrence
   - A group of limbs within a 1-foot section of the bole with a total sum of diameters equal to 1/2 or more of the bole diameter at the point of occurrence

4. Hold the clinometer up to one eye, keeping both eyes open.

   NOTE: You will be looking through the lens and alongside the clinometer housing at the same time, causing an optical illusion in which the horizontal sightline appears to extend through the housing and onto your target. Hold the clinometer steady.

5. Sight the clinometer at the point of top merchantability.

6. Read the scale: It represents the distance from eye level to the top of the merchantable height.

7. Sight the clinometer on the tree at stump height, one foot above ground level.

8. Read the scale: It represents the distance from eye level to stump height.

9. Compute the total height according to your position relative to the tree as shown in Supplement 2.

   If the readings are on opposite sides of the scale, positive and negative, add the readings together to find the height of the tree.

   If the readings are both positive or both negative, subtract the readings to find the height of the tree.

10. Record your final reading of merchantable height.

	Tree No.	Merchantable height
1.	______________	______________

   NOTE: On the practical test, you will measure the merchantable height of 10 trees.

11. Have your instructor check your work.

PRACTICAL TEST 1

PRACTICE TREE MEASUREMENT

IX

JOB SHEET 1

Measure diameter using a diameter tape.

Student's name ______________________ Date __________

Evaluator's name ______________________ Attempt no. _____

Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation. Use the worksheet for Practical Test 1 following this practical test.

PROCESS EVALUATION

Evaluator note: Write a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.

The student:	YES	NO
1. Measured 4 1/2 feet on the side of the tree.	_____	_____
2. Found this height on the body for DBH height reference.	_____	_____
3. Selected the correct placement of the DBH measure.	_____	_____
4. Turned the tape so the diameter measure is on the outside of the tape.	_____	_____
5. Extended the tape around the tree from the left side.	_____	_____
6. Grasped the hook end of the tape with the right hand.	_____	_____
7. Pulled the tape taut with hands crossed over each other, left hand on top.	_____	_____
8. Read the tape at the point of intersection of '0' mark and diameter marks.	_____	_____
9. Recorded the DBH to the nearest 1/10 inch of diameter.	_____	_____

The student:	YES	NO
10. Recorded the class and recorded the DBH in its proper class.		
Tree No.		
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11. Used proper tools correctly.		
12. Performed steps in a timely manner.		
13. Practiced safety rules throughout procedure.		
14. Provided satisfactory responses to questions asked.		
15. Put away tools and cleaned work area.		

EVALUATOR'S COMMENTS

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See performance evaluation key). A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:				
	4	3	2	1
Used correct procedures to measure DBH				
	4	3	2	1
Measured DBH to within 1/10 inch				

Criteria:

Noted class	4	3	2	1
Recorded DBH in its proper class	4	3	2	1

EVALUATOR'S COMMENTS

____

____

____

AVERAGE RATING

Evaluator note: To obtain an average rating for the competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

PERFORMANCE EVALUATION KEY

4 - Skilled—Can perform job with no additional training

3 - Moderately skilled—Has performed job during training program, limited additional training may be required

2 - Limited skill—Has performed job during training program; additional training is required to develop skill

1 - Unskilled—Is familiar with process, but is unable to perform job

Worksheet for Practical Test 1

NAME ______________________________

Measure the diameter of the trees indicated by your instructor using a diameter tape. Read the tape to the nearest 1/10 inch of diameter, note the class and record the DBH in its proper class.

Tree No.	DBH to 1/10 in	Class 1 in or 2 in	DBH
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

PRACTICAL TEST 2

PRACTICE TREE MEASUREMENT

IX

JOB SHEET 2

Measure diameter using a Biltmore stick.

Student's name ____________________________ Date ___________

Evaluator's name ___________________________ Attempt no. _____

Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation. Use the worksheet for Practical Test 2 following this practical test.

PROCESS EVALUATION

Evaluator note: Write a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.

The student:	YES	NO
1. Selected the correct place to measure the DBH according to the rules for measurement.	______	_____
2. Tied a length of string to a button and trimmed it so that the end of the string was 25 inches from the body.	______	_____
3. Placed the stick horizontally against the tree at DBH with the left edge of the stick along one edge of the tree, held it level with the thumb *outside* the bark.	______	_____
4. Stood so that the stick was held 25 in from the eye (string's length).	______	_____
5. Placed the stick 4 1/2 ft high, horizontally against the tree with the left edge of the stick along one edge of the tree.	______	_____
6. Closed one eye.	______	_____
7. Without moving the head, read the diameter along the stick.		

The student:	YES	NO
8. Recorded the diameter for 10 trees.		
1.	______	______
2.	______	______
3.	______	______
4.	______	______
5.	______	______
6.	______	______
7.	______	______
8.	______	______
9.	______	______
10.		
9. Used proper tools correctly.	______	______
10. Performed steps in a timely manner.	______	______
11. Practiced safety rules throughout procedure.	______	______
12. Provided satisfactory responses to questions asked.	______	______
13. Put away tools and cleaned work area.	______	______

EVALUATOR'S COMMENTS

____

____

____

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See performance evaluation key). A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:				
Handled Biltmore stick correctly	4	3	2	1
Measured DBH	4	3	2	1

EVALUATOR'S COMMENTS

____

____

____

AVERAGE RATING

Evaluator note: To obtain an average rating for the competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

PERFORMANCE EVALUATION KEY

4 - Skilled—Can perform job with no additional training

3 - Moderately skilled—Has performed job during training program, limited additional training may be required

2 - Limited skill—Has performed job during training program; additional training is required to develop skill

1 - Unskilled—Is familiar with process, but is unable to perform job

Worksheet For Practical Test 2

NAME ______________________________

Measure the diameter of the trees indicated by your instructor using a Biltmore Stick. Record the diameter for 10 trees.

Tree No.	DBH
1.	___________
2.	___________
3.	___________
4.	___________
5.	___________
6.	___________
7.	___________
8.	___________
9.	___________
10.	___________

PRACTICAL TEST 3

PRACTICE TREE MEASUREMENT

IX

JOB SHEET 3

Measure height with a Biltmore stick.

Student's name ____________________________ Date ___________

Evaluator's name __________________________ Attempt no. _____

Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation. Use the worksheet for Practical Test 3 following this practical test.

PROCESS EVALUATION

Evaluator note: Write a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.

The student:	YES	NO
1. Paced or measured a distance of 1 chain from the tree, at about the same elevation as the tree.	_____	_____
2. Tied a string to a shirt button and trimmed it so that the end of the string was 25 inches from the eye.		
3. Held the stick vertically, with the Merritt hypsometer facing student, approximately 25 inches from the eye.	_____	_____
4. Lined up the bottom of the scale with the stump level, 1 foot above the ground.	_____	_____
5. Without moving the head, read the number of logs on the scale at the point on the stick even with the top of the tree or at merchantable height:	_____	_____
6. Recorded readings on the chart.		
Tree No.		
1.	_____	_____
2.	_____	_____
3.	_____	_____
4.	_____	_____
5.	_____	_____
6.	_____	_____
7.	_____	_____
8.	_____	_____

The student:	YES	NO
Tree No.		
9.		
10.		
7. Used proper tools correctly.		
8. Performed steps in a timely manner.		
9. Practiced safety rules throughout procedure.		
10. Provided satisfactory responses to questions asked.		
11. Put away tools and cleaned work area.		

EVALUATOR'S COMMENTS

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See performance evaluation key). A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:				
Correct use of Merritt Hypsometer	4	3	2	1
Measurement of actual height	4	3	2	1
Measurement of merchantable height	4	3	2	1

EVALUATOR'S COMMENTS

AVERAGE RATING

Evaluator note: To obtain an average rating for the competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

PERFORMANCE EVALUATION KEY

4 - Skilled—Can perform job with no additional training
3 - Moderately skilled—Has performed job during training program, limited additional training may be required
2 - Limited skill—Has performed job during training program; additional training is required to develop skill
1 - Unskilled—Is familiar with process, but is unable to perform job

Worksheet For Practical Test 3

NAME ____________________

Measure the height of the trees indicated by your instructor using a Biltmore Stick.

Tree No.	"S" Sawtimber "P" Pulpwood	No. of logs in total ht.	No. of logs in merchantable ht.
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

PRACTICE TREE MEASUREMENT

JOB SHEET 4

Measure merchantable height using a Suunto clinometer.

Student's name ______________________ Date __________

Evaluator's name ______________________ Attempt no. _____

Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation. Use the worksheet for Practical Test 4 following this practical test.

PROCESS EVALUATION

Evaluator note: Write a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.

The student:	YES	NO
1. Selected the percent scale.	_____	_____
2. Measured a distance of 100 feet from the tree to a point where both top and bottom of the tree could be seen.	_____	_____
3. Estimated the point of top merchantability using these guidelines. – Minimum top of 7.0 inches DOB – A fork with less than 8 feet in either fork – A limb with a diameter equal to 1/2 or more of the bole diameter at the point of occurrence – A group of limbs within a 1-foot section of the bole with a total sum of diameters equal to 1/2 or more of the bole diameter at the point of occurrence	_____	_____
4. Held the clinometer up to one eye, keeping both eyes open.	_____	_____
5. Sighted the clinometer at the point of top merchantability.	_____	_____
6. Read the scale representing the distance from eye level to the top of the merchantable height.	_____	_____

The student:	YES	NO
7. Sighted the clinometer on the tree at stump height.	____	____
8. Read the scale representing the distance from eye level to stump height.	____	____
9. Computed the total height according to relative position to the tree.	____	____
10. Recorded the merchantable height for 10 trees.		
1.	____	____
2.	____	____
3.	____	____
4.	____	____
5.	____	____
6.	____	____
7.	____	____
8.	____	____
9.	____	____
10.	____	____
11. Used proper tools correctly.	____	____
12. Performed steps in a timely manner.	____	____
13. Practiced safety rules throughout procedure.	____	____
14. Provided satisfactory responses to questions asked.	____	____
15. Put away tools and cleaned work area.	____	____

EVALUATOR'S COMMENTS

____

____

____

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See performance evaluation key). A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:				
Use of the Suunto clinometer	4	3	2	1
Measured merchantable height of trees	4	3	2	1

EVALUATOR'S COMMENTS

____

____

____

AVERAGE RATING

Evaluator note: To obtain an average rating for the competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

PERFORMANCE EVALUATION KEY

4 - Skilled—Can perform job with no additional training

3 - Moderately skilled—Has performed job during training program, limited additional training may be required

2 - Limited skill—Has performed job during training program; additional training is required to develop skill

1 - Unskilled—Is familiar with process, but is unable to perform job

Worksheet For Practical Test 4

Measure the merchantable height of the trees indicated by your instructor using a Suunto clinometer.

Tree No. Merchantable height

1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________
6. ____________________
7. ____________________
8. ____________________
9. ____________________
10. ____________________

WRITTEN TEST

PRACTICE TREE MEASUREMENT

IX

NAME ______________________________ SCORE _______

OBJECTIVE 1

Match terms associated with tree measurements to their correct definitions. Write the correct letters in the blanks.

____ 1. The gradual reduction in stem diameter from the base to the top

____ 2. Can be saved or salvaged

____ 3. Distance through the center of the tree

____ 4. Trees that yield lengths suitable in size and quality for the production of lumber

____ 5. Diameter inside the bark

____ 6. The tree trunk or stem

____ 7. The cross-sectional area of trees at stump height, expressed in square feet per acre; used to determine volume

____ 8. A collective term for all instruments used for measuring diameter

____ 9. Diameter outside the bark

____ 10. A collective term for all instruments used for measuring height

____ 11. Height suitable for marketing and utilization according to specifications of an organization or industry

____ 12. Thousand board feet

____ 13. A tree or log of merchantable size that is unmerchantable because of poor form, too many limbs, rot, or other defect, or an undesirable species

____ 14. A usable length of timber

____ 15. The taper of a tree trunk; expressed as a percentage ratio of the diameter outside the bark at breast height and the diameter inside the bark at the top of the first 16-foot log

a. Altimeter

b. Basal area

c. BFA

d. Bole

e. Circumference

f. Cull

g. Damaged

h. Form class

i. DBI

j. DBO

k. Dendrometer

l. Diameter

m. DIB

n. DOB

o. Estimated height

p. Hypsometer

q. MBF

r. MIL

s. Merchantable height

t. Radius

u. Salvable

v. Sawlog

w. Sawtimber

x. Stumpage

y. Taper

___16. A measurement of stacked wood piled four feet high, four feet wide, and eight feet long; occupying 128 gross cubic feet of space (wood and air spaces between pieces of wood) and 80 cubic feet of solid wood

___17. Distance around the outside of the tree

___18. The arrangement of several branches growing from a single stem

___19. The equivalent of 100 cubic feet of wood

___20. Diameter measured at 4 1/2 feet from the ground

___21. A unit of wood 1 x 12 x 12 inches, used in volume measurements

___22. Lengths of pulpwood

z. Racks

aa. Circumference

bb. Cord

cc. Cubit

dd. Cunit

ee. Fork

ff. DBH

gg. Percentile

hh. Board Foot

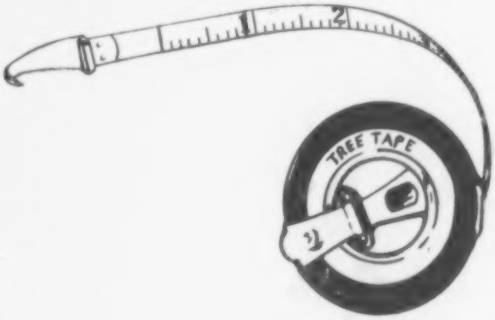
ii. Sticks

jj. Whorl

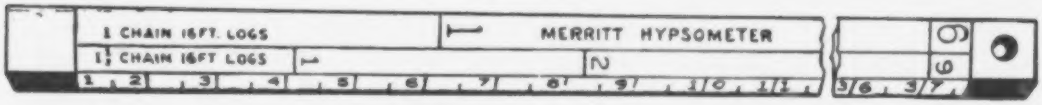
OBJECTIVE 2

Name tools used in taking tree measurements. Write the correct names in the blanks.

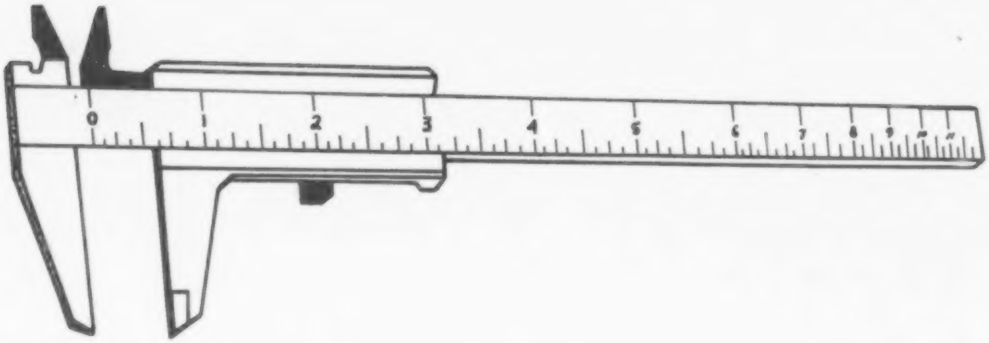
Dendrometers



1. ____

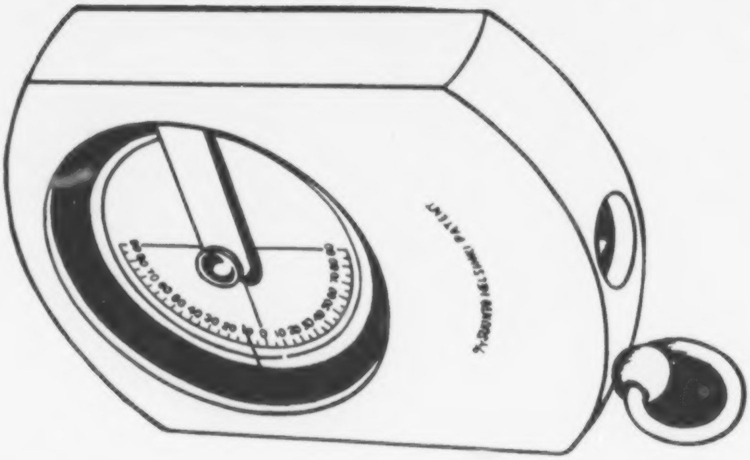

1 CHAIN 16FT. LOGS
1½ CHAIN 16FT LOGS
MERRITT HYPSOMETER

2.____

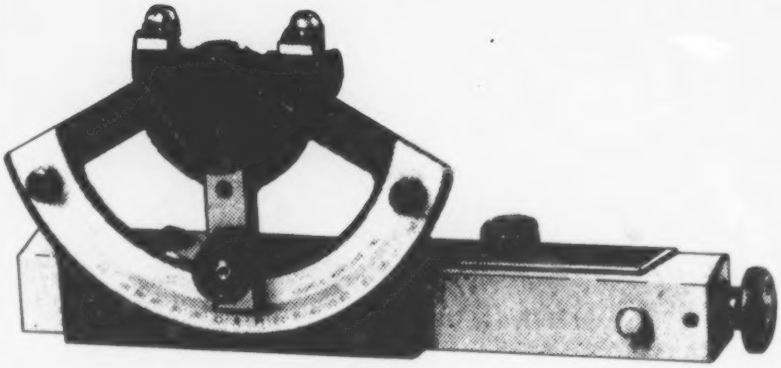


3.____

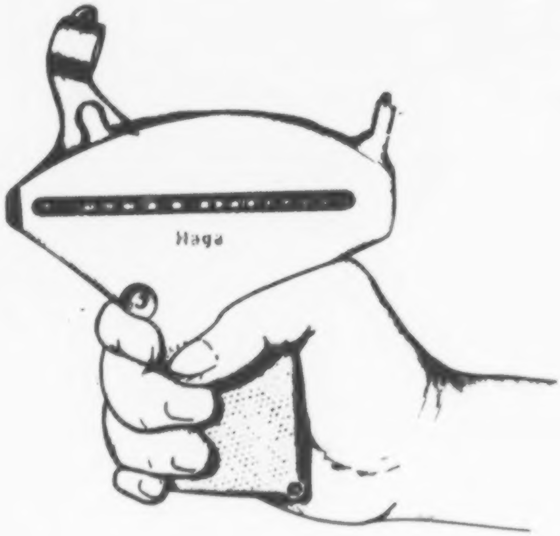
Hypsometers



4. ______________________________

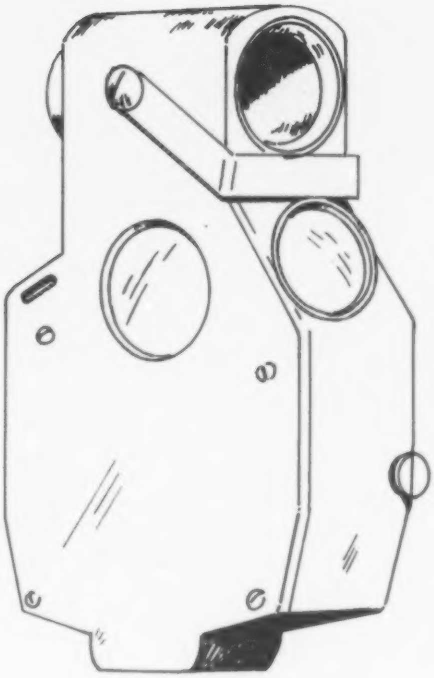


5.____



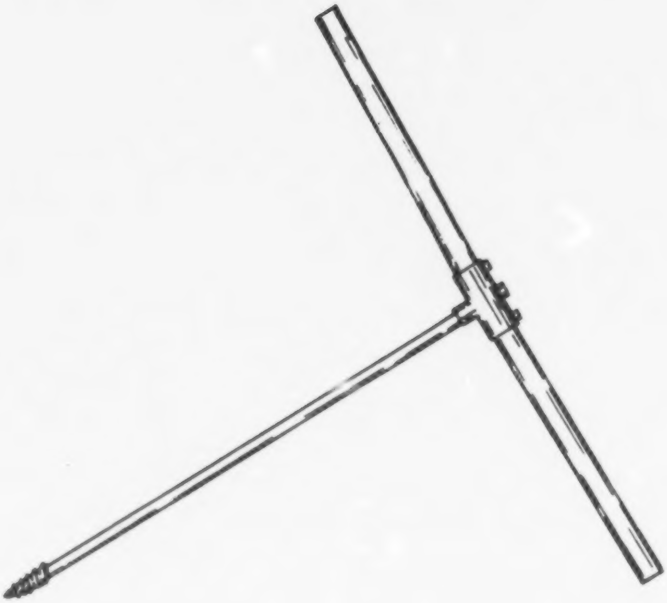
6.____

Other tools

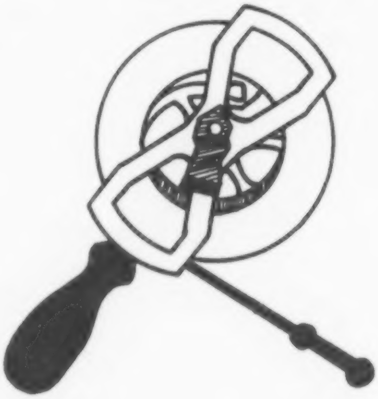


7. ______________________________

651



8.______________________________



9.______________________________

052

OBJECTIVE 3

Classify DBH measurements into the correct diameter classes. Write the correct answers in the blanks.

One-inch

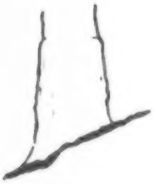
1. 5.9 in ______________
2. 5.0 in ______________
3. 8.3 in ______________

Two-inch

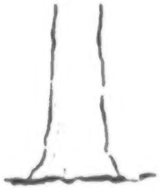
4. 9.6 in ______________
5. 11.1 in ______________
6. 14.5 in ______________

OBJECTIVE 4

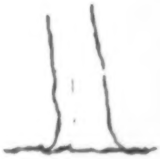
Determine the correct location of DBH measurements. Draw a line indicating the correct locations.



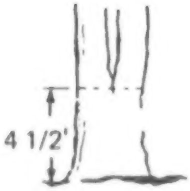
1. Tree on Slope



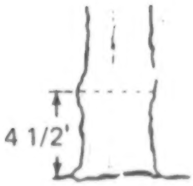
2. Tree on Level Ground



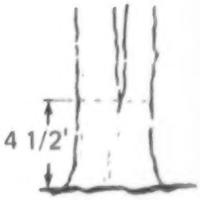
3. Leaning Tree



4. Tree Forking at or Above 4 1/2 Feet



5. Tree Deformed at 4 1/2 Feet



6. Tree Forking Below 4 1/2 Feet

OBJECTIVE 5

Complete statements concerning merchantable height. Write the correct answers in the blanks.

1. Minimum DBH for pulpwood is usually ________ .
2. In Western forests merchantable height of sawtimber is based on a log length of ______ .
3. Sawlog lengths are usually recorded to the nearest __________ .
4. In some instances the height of the total tree is used to measure _________________ .
5. In eastern or southern forests a sawtimber tree with a merchantable height of 50 ft would be tallied as _____________ logs.
6. Depending on use, minimum DBH for sawtimber is _________ .
7. In eastern and southern forests the merchantable height of sawtimber is considered to be the number of ________ ft half-logs and logs with a length of _________ .
8. A pulpwood tree with a merchantable height of 36 ft is considered to contain _______________ 4 ft logs.
9. Nine trees in the 2-inch class are to be cut from a certain stand. One-third of the trees have a DBH of 5.6 in to 6.4 in, one-third have a DBH of 3.2 in-4 in, and one-third have a DBH of 7.3 in to 8.9 in.

   This stand has ________ sawtimber trees and ____________ pulpwood trees.
10. Pulpwood height is estimated to a point where the diameter of the tree trunk tapers to __________ .

OBJECTIVE 6

Distinguish among major log scales. Circle the correct answer.

1. Log rules determine volume in_____.

   a. cubic feet

   b. cords

   c. board feet

   d. tons

2. Log rules determine volume according to_____.

   a. form class, DBH, and species

   b. form class, DBH, and tree height

   c. DBH, DIB, and tree height

   d. DBH, species, and tree height

3. You have two 11-inch stems, one has a merchantable height of 1 log and the other has a merchantable height of 2 1/2 logs. What is the total combined volume of both stems? Use the Doyle Log Rule below.

   a. 57

   b. 62

   c. 42

   d. 67

Number of 16-foot logs

DBH	1	1 1/2	2	2 1/2	3	3 1/2	4
10	14	17	20	21	22		
11	22	27	32	35	38		
12	29	36	43	48	53	54	56
13	38	48	59	66	73	76	80

4. All of the following log rules are in common use EXCEPT___.

   a. Doyle

   b. International

   c. Scribner

   d. Southern

OBJECTIVE 7 **Draw tally symbols.**

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

NOTICE The following assignment sheets and job sheets are not part of the written test. If these activities have not been completed, check with your instructor.

OBJECTIVE 8 **Determine merchantable height of trees.** SCORE ________

OBJECTIVE 9 **Complete a tally sheet.** SCORE ________

OBJECTIVE 10 **Calculate estimated volume, weight, and value of timber.** SCORE ________

OBJECTIVE 11 **Demonstrate the ability to**

a. Measure diameter using a diameter tape. RATING ______

b. Measure diameter using a Biltmore stick. RATING ______

c. Measure height using a Biltmore stick. RATING ______

d. Measure merchantable height using a Suunto clinometer. RATING ______

WRITTEN TEST ANSWERS

PRACTICE TREE MEASUREMENT

IX

OBJECTIVE 1

1. y
2. u
3. l
4. w
5. m
6. d
7. b
8. k
9. n
10. p
11. s
12. q
13. f
14. v
15. h
16. bb
17. aa
18. jj
19. dd
20. ff
21. hh
22. ii

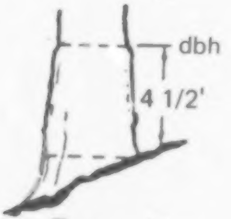
OBJECTIVE 2

1. Diameter Tape
2. Biltmore stick
3. Calipers
4. Suunto clinometer
5. Abney hand level
6. Haga altimeter
7. Relaskop
8. Increment borer
9. Tapes

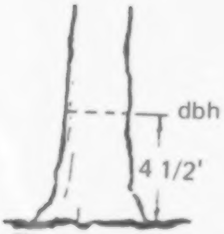
OBJECTIVE 3

1. 6 in
2. 5 in
3. 8 in
4. 10 in
5. 12 in
6. 14 in

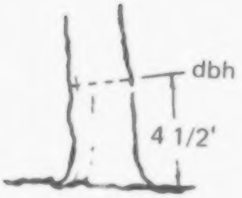
OBJECTIVE 4



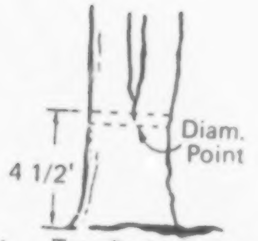
1. Tree on Slope



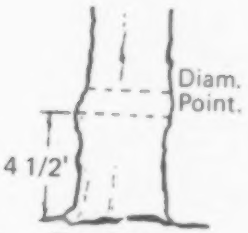
2. Tree on Level Ground



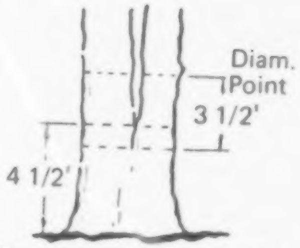
3. Leaning Tree


4 1/2'
Diam.
Point

4. Tree Forking at or Above 4 1/2 Feet


Diam.
Point.
4 1/2'

5. Tree Deformed at 4 1/2 Feet


Diam.
Point
3 1/2'
4 1/2'

6. Tree Forking Below 4 1/2'

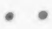
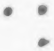
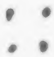
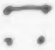
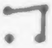
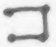
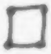
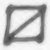
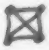
OBJECTIVE 5

1. 4 in
2. 32 ft
3. half log
4. pulpwood
5. 3
6. 10 in
7. 8, 16 ft
8. 9
9. 6, 3
10. 4 in

OBJECTIVE 6

1. c
2. b
3. a
4. d

OBJECTIVE 7

1.
2. 
3. 
4. 
5. 
6. 
7. 
8. 
9. 
10. 

OBJECTIVE 8 Refer to answers to Assignment Sheet 1.

OBJECTIVE 9 Refer to answers to Assignment Sheet 2.

OBJECTIVE 10 Refer to answers to Assignment Sheet 3.

OBJECTIVE 11a-d Refer to Practical Tests for Job Sheets 1 through 4.

OBJECTIVE SHEET

USE BASIC SURVEYING TECHNIQUES

X

INTRODUCTION

Forest surveying is essential for cruising or estimating the value of a stand of timber. Because forest surveying is used primarily for estimating rather than for creating exact maps or for building construction, the methods are simple and easy to learn. Surveying is an interesting part of foresters' work. They work outside with partners in different terrains, among forest plants and wildlife. Many foresters enjoy their surveying assignments.

UNIT OBJECTIVE

After completing this unit, the student should know the basic procedures, calculations and tools of forest surveying and should be able to convert compass readings, adjust a compass to true north, use pacing and chaining to measure horizontal distances and angles, and chain a slope. The student will demonstrate these competencies by completing the assignment sheets, job sheets and written test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with surveying to their correct definitions.
2. Choose words or phrases to complete statements about why surveying is important in forestry.
3. Select from a list characteristics of a forest survey.
4. Match surveying tools to their descriptions.
5. Label parts of a compass.
6. Match compass measurements to their values and symbols.
7. Distinguish between azimuths and bearings.
8. Choose the best word or phrase to complete statements about pacing.
9. Convert chaining measurements.
10. Distinguish between survey team members' tasks.
11. Use an isogonic chart to correct magnetic readings to true readings. (Assignment Sheet 1)

12. Demonstrate the ability to

    a. Adjust the compass to true readings. (Job Sheet 1)

    b. Determine the length of your pace. (Job Sheet 2)

    c. Pace unknown distances. (Job Sheet 3)

    d. Chain a horizontal distance as the head chain person. (Job Sheet 4)

    e. Chain a horizontal distance as the rear chain person (Job Sheet 5)

    f. Lay out a right-angle offset. (Job Sheet 6)

    g. Chain a slope. (Job Sheet 7)

PREPARATION

- Obtain materials to supplement unit.

  NOTE: See Suggested Resources

- Obtain tools and supplies:

  - 1-chain or 2-chain surveyor's tape with 66′ chains, with trailer

    NOTE: Many types of tapes are available at a range of prices. Dr. David Robinson of the Oklahoma State University Forestry Department has taught these basic surveying skills for 30 years and recommends that teachers buy rope chains. They are plastic-coated, flexible, and will withstand the stress of student use that can easily break a steel tape.

  - Compass

    NOTE: Select an azimuth model with a declination adjustment screw and with a rotating compass dial, graduated in degrees. Students should be able to work with both azimuths and bearings, but a compass marked in azimuths is more appropriate for most forestry tasks. If a compass does not have a declination ring, it is easier to lay off the correct angles in azimuths.

  - Abney hand level

    NOTE: Be sure the level is properly adjusted, and the topographic/percent scale is on the outside.

  - Field note books, clipboards, pocket notepads or other recording method

  - *Forestry Suppliers, Inc., Catalog*

  - Flagging tape

- Review instructional outline for this unit. Modify time frames to suit class needs and plan activities for each class period.

- Study specific objectives to determine those you will cover in your presentation. Decide which objectives should be taught to which students.

- Determine scope and sequence of objectives that you add. Design and develop support materials, including evaluation techniques, for additional objectives.

- Determine how you will schedule time for students to demonstrate competence in the required procedures.

- Invite a forester or survey team to talk to students about forest surveying. Ask the speakers to discuss why surveying is important to forestry and to demonstrate tools and procedures, including distance measuring wheels, rope chains, different types of levels and other equipment not covered in the unit.

  NOTE: Supply guest speakers with specific objectives and other appropriate sections of the unit.

- Refer to rules and regulations for The National or State FFA Forestry Contest. The knowledge and skills required that are covered in this unit are listed below.

  In the national contest:

  - Ability to identify forestry measurement and scaling equipment

    Steel tape
    Plastic flagging
    Hand compass
    Staff compass

  - Ability to use a hand compass

    Use a hand compass and pacing to simulate the determination of property lines of a tract of timber

  In the Oklahoma state competition:

  - Compass and pacing

    Follow a course and record correct compass readings within 2 degrees and distances within 2 feet

    Adjust compass for correct declination

- Locate areas for practice surveying and for the job sheets:
  - Horizontal distance for learning an open or closed traverse
  - Slope for learning how to chain a slope
  - Straight, level 100-ft course (such as a football field) for learning pacing
  - Minimum of three areas, such as a hallway, grassy area, parking lot, etc., for students to measure by pacing
  - Course with an obstacle such as a small pond, building, truck, or dumpster to learn how to lay out a right-angle offset

DELIVERY

Objective 1

- Review terms with students. Provide examples or stories to help students understand and remember the terms.

Objective 2

- Discuss with the class or invite a forester to discuss why surveying is important to forestry.
- Emphasize the value of learning surveying skills such as taping, pacing, knowing how to measure one's own home lot or farm areas, and using a compass.
- Have students ask their parents for the survey of their home or farm so they can relate surveying to their lives.
- Explain that for students who are able and interested, there is the opportunity to learn and use higher math if they want to pursue surveying.
- Present a simple example of the results of a survey. Estimate the value of timber after the survey team has marked the boundaries of the cruise. Encourage students to provide values such as the size of the area; any obstacles such as rivers, impassible thickets, ponds, etc; types of trees; sizes of trees; and imaginary or local actual dollar values.

Objective 3

- Arrange for a demonstration by experienced forest surveyors.

- Take students to a site that has been surveyed and flagged. If possible, arrange for a survey team to demonstrate and explain their procedures.

- Have students study Supplement 4–Common Errors in Chaining.

Objective 4

- Have all tools available to students.

- If you have both engineering and Gunter's chain tapes, compare the graduations and tape lengths.

- Have students convert measurements in both systems.

- Activity Sheet 4 explains how to use the Abney hand level so students can complete Job Sheet 7 on chaining a slope. You can teach students how to use the level at this time or wait until you teach the job sheet.

- Stress to interested students that the National FFA Forestry Contest includes knowledge and skills from this objective:

  - Ability to identify forestry measurement and scaling equipment

    Steel tape
    Plastic flagging
    Hand compass
    Staff compass

Objectives 5 and 6

- Supply students with compasses. Review parts of the compass. Discuss variations in compass designs, especially if you have more than one type available.

- Demonstrate how to use the compass.

- Have students complete Activity Sheet 1.

- Give students reference points outside or in the room and ask them to find the compass reading. Warn students that metal objects and buildings can affect the compass reading.

- Stress to interested students that the National FFA Forestry Contest includes knowledge and skills from this objective:
  - Ability to use a hand compass
  - Using a hand compass and pacing to simulate the determination of property lines of a tract of lumber
- Stress that orienteering is an activity that makes use of compass skills. There are books on the subject, orienteering clubs, and several levels of competition, including nationals. Orienteering, whether as a hobby or a major interest, sharpens important survival skills.

Objective 7

- Use Transparency 1 to compare the placement of azimuths and bearings on the compass face.
- Have students complete Activity Sheet 2.
- Use Supplement 1 to discuss meridians.
- Use a globe or world map to show meridians.
- Locate the Hudson Bay Area and identify the magnetic north pole.
- Locate an assumed meridian such as a north-south road, and let students compare the magnetic reading on the needle to true north.
- Have students complete Assignment Sheet 1. Refer them to Supplements 1, 2 and 3 on magnetic declination, the isogonic chart, and angle corrections.
- Give advanced or interested students Handout 2 and give them the opportunity to explore another aspect of surveying or orienteering.

Objective 8

- Allow students plenty of practice time pacing before they complete the job sheet.
- Remind interested students that pacing skills are part of the State and National FFA Forestry Contest.
- Have several students compare the length of their paces to demonstrate the difference in individual strides.

- Locate or construct a slope situation for students to observe how the length of the pace changes on uphill and downhill slopes.
- Have students complete Job Sheet 2.
- Measure and mark a minimum of three areas such as hallways, grass areas, parking lot, or other area for students to pace three unknown distances in Job Sheet 3.
- Have students complete Job Sheet 3.

Objective 9

- Show chaining tape and discuss graduations and relationships.
- Use Transparency Master 2 to help students understand the relationship of chains to acres and miles.
- Have students complete Activity Sheet 3 to give them practice with conversions and basic math skills. Add problems and challenge students to measure and compete as teams.

Objective 10

- Demonstrate the duties of head and rear chain persons, or have a team of foresters demonstrate the various tasks and procedures.
- Refer students to Supplement 4 and Supplement 5.

  NOTE: Stress to students that there is no standardized system for forest surveys and suggest they devise their own method as they learn chaining, pacing and using the compass.
- Have students practice chaining a straight horizontal distance.
- Use the azimuths in Activity Sheet 2, or create new ones, and have students find those readings using the compass.
- Mark off an artificial obstacle and have students practice creating and measuring angles and taking backsights.
- Lay out a course with horizontal distances and angles for students to complete Job Sheets 4, 5 and 6.
- Give advanced or interested students Handout 1.
- Review procedures for using the Abney hand level.

- Demonstrate how to chain a slope using a slope tape and an Abney hand level.
- Provide opportunities for students to practice chaining a slope.
- Have students complete Job Sheet 7.

APPLICATION

Objective 11

- Use Assignment Sheet 1 to give students practice in correcting magnetic readings to true readings and to reinforce math skills.

  NOTE: Supplements 2 and 3 support this assignment sheet. The Isogonic Chart provides the data students need to complete the assignment sheet. Angle Corrections provide a visual image of correcting magnetic readings to true readings.

Objectives 12a through 12g

- Use Job Sheet 1 to teach students how to adjust the compass.

  NOTE: Use Activity Sheet 1 to review how to use and read a compass.

- Use Job Sheet 2 to teach students how to determine the length of their paces.
- Use Job Sheet 3 to teach students to pace unknown distances.
- Use Job Sheet 4 to teach students how to chain a horizontal distance as the head chain person.
- Use Job Sheet 5 to teach students how to chain a horizontal distance as the rear chain person.
- Use Job Sheet 6 to teach students how to lay out a right-angle offset.
- Use Job Sheet 7 to teach students how to chain a slope.

  NOTE: Demonstrate how to use the Abney hand level. Have students complete Activity Sheet 4. Allow students to practice. Be sure the topographic scale is on top and the level is properly aligned.

EVALUATION

Practical test

- Explain to students that they will be asked to demonstrate procedures on the job sheets to complete the practical test.
- Describe the rating scale used on the practical test.
- Give practical test.
- Reteach and retest as needed.

Written Test

- Explain to students that they will be asked to demonstrate on the written test actions listed in the specific objectives.
- Give written test.

  NOTE: The written test may be given in sections if desired.
- Evaluate students on assignment sheet activities if not previously done.
- Reteach and retest if necessary.
- Complete appropriate section of competency profiles.
- Review individual and group performance in order to evaluate teaching methods. Adjust scope, sequence, or instructional approaches for additional lessons as required.

SUGGESTED RESOURCES

Publications

- *Forestry Suppliers, Inc. Catalog*, Forestry Suppliers, Inc., P.O. Box 8397, Jackson, MS 39284-8397, telephone (800) 647-5368.
- Orienteering Services, USA, P.O. Box 1604, Binghamton, NY 13902, (607) 724-0411. Information about orienteering teaching aids and equipment.

Speakers

Oklahoma Natural Resources Speakers Bureau sponsored through Oklahoma State University, Division of Agriculture, Oklahoma Cooperative Extension Service–Forestry, Oklahoma Conservation Commission and the Oklahoma Forestry Association. Lists speakers on a variety of forestry-related topics. Speakers operate on a time-available basis. Request a listing of speakers, programs, slides presentations and videotapes from your local extension office or from:

Dr. Steve Anderson
Forestry Dept.
Oklahoma State University
239 Agricultural Hall
Stillwater, OK 74078
(405) 744-9431

Dave Marcouiller
Forestry Dept.
Oklahoma State University
242 Agricultural Hall
Stillwater, OK 74078
(405) 744-5444

Teachers from outside of Oklahoma should contact the Forestry Extension Office in their state.

UNIT REFERENCES

- *Abney Levels: Uses and Applications with Appropriate Tables.* Keuffel & Esser Co., New York, n.d.
- *Forestry Aid Curriculum for Native Americans*, Arizona Center for Vocational Education, Northern Arizona University, Flagstaff, Arizona, 1984.
- Hammett, Catherin T., *Your Own Book of Campcraft*, Pocket Books, New York, 1950.
- *Harvesting Forestry Products*, Vocational Instructional Services, Texas A & M University, College Station, Texas, 1976.
- Hines, Frederick, L. *Boy Scout Handbook*, 8th ed., Boy Scouts of America, North Brunswick, New Jersey, 1972.
- Olson, David A., *Basic Surveying Technology*, Mid-America Vocational Curriculum Consortium, Inc., Stillwater, Oklahoma, 1987.
- Schertz, Karen, *Civil Drafting*, The Mid-America Vocational Curriculum Consortium, Inc., Stillwater, Oklahoma, 1986.
- Schwab, Glenn O., et al, *Elementary Soil and Water Engineering*, John Wiley & Sons, New York, 1966.
- *Silva Ranger Model Compass Instruction Manual*, Silva, Inc., Laporte, Indiana.

- Surveyor 3 & 2, United States Government Printing Office, NAVPERS 10632-B, Washington, D. C., 1955.

CONVERT BEARINGS TO AZIMUTHS AND AZIMUTHS TO BEARINGS.

Convert bearings to azimuths:

When the line is in this quadrant for azimuth	To convert bearing to azimuth:	Formula
Northeast	do not convert	NE Bearing = Az
Southeast	subtract bearing from 180°	SE = 180°–bearing
Southwest	add bearing and 180°	SW = 180° + bearing
Northwest	subtract bearing from 360°	NW = 360°–bearing

NOTE: Notice the pattern as you go around the compass: The number always comes first; NE no change, SE subtract, SW add, NW subtract.

Convert azimuths to bearings

When azimuth is in this quadrant	To convert azimuth to bearing:	Formula for Bearing
Northeast, 0-90°	do not convert	Az = Bearing
Southeast, 90-180°	subtract azimuth from 180°	SE = 180° – Az
Southwest, 180°-270°	subtract 180° from azimuth	SW = Az – 180°
Northwest, 270°-360°	subtract azimuth from 360°	NW = 360° – Az

NOTE: Always **subtract** to convert azimuths to bearings. Notice the pattern as you go around the compass: NW—no change, SE—number first, SW—Az first, SW—number first.

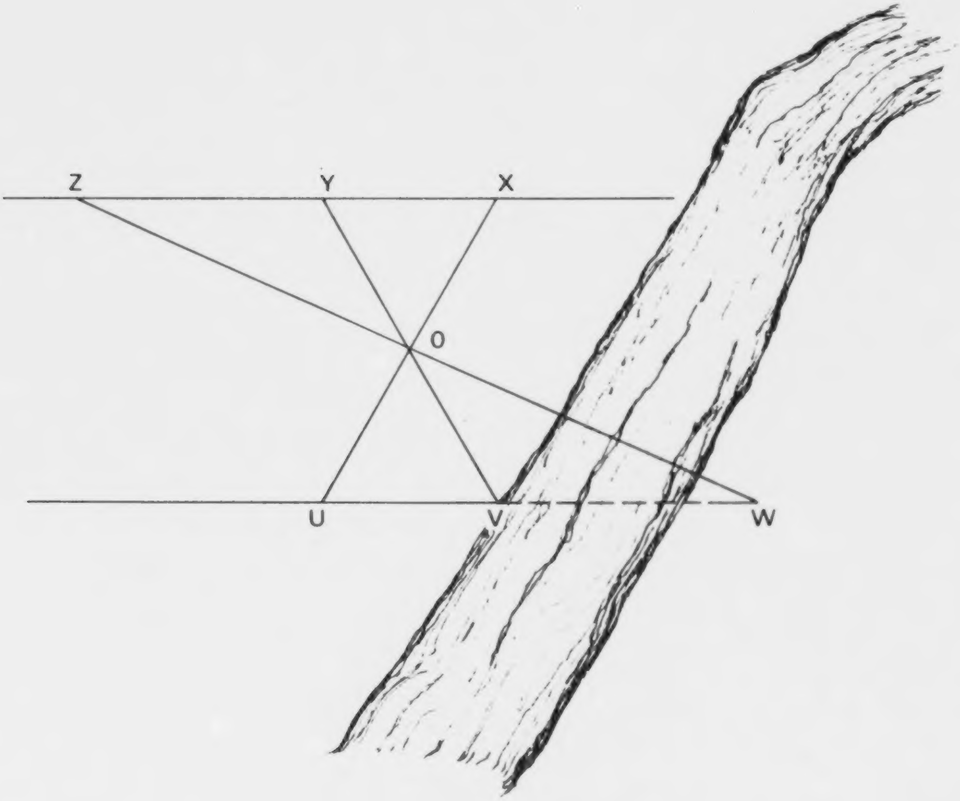
Az at 0° or 360° = bearing of *due north*
Az of 90° = bearing of *due east*
Az of 180° = bearing of *due south*
Az of 270° = bearing of *due west*

When azimuth is in this quadrant	To convert azimuth to bearing:	Formula for Bearing
Northeast, 0-90°	do not convert	AzS = Bearing
Southeast, 90-180°	subtract azimuth from 180°	NW = 180°–AzS
Southwest, 180°-270°	subtract 180° from azimuth	NE = AzS–180°
Northwest, 270°-360°	subtract azimuth from 360°	SW = 360°–AzS

NOTE: You still subtract. The pattern you used with Azimuth North is the same, but it is shifted 180° around. Remember, you always read azimuths in a clockwise direction.

HOW TO MEASURE INACCESSIBLE LINES

When rivers, canyons, thick brush or other obstacles are too big to go around, offsetting techniques won't work. If an "inaccessible line" continues across a canyon or runs to the middle of a river, you will create angles and lines that are the same as the angles and lines that you can't reach.



Measure Inaccessible Lines

The inaccessible line is line V-W, across the river.

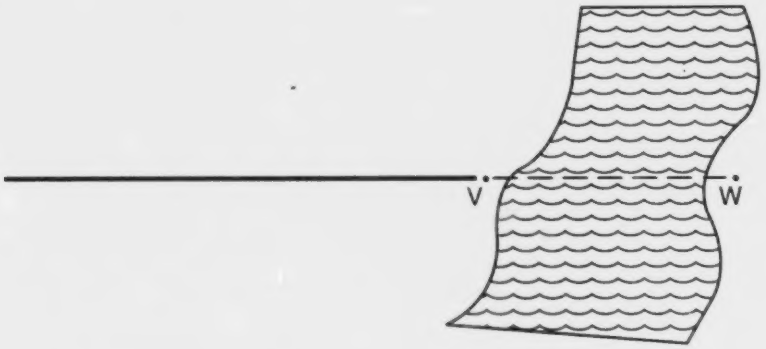
Notice that triangle YOX is exactly the same as triangle UOV, where V is the first point in the inaccessible line, V-W. Triangle ZOY is a reversed, upside-down copy of triangle VOW, where W is the endpoint of the inaccessible line.

When you measure the line Z-Y, you will have the distance of the line W-V.

To measure the distance between V and W:

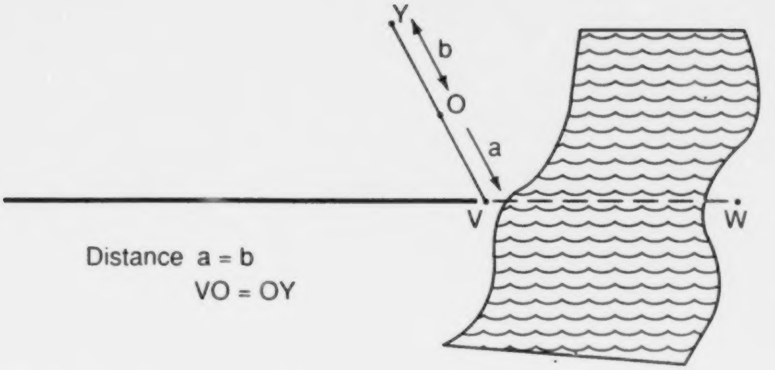
NOTE: Take careful measurements and draw them carefully on a grid in your field book. Take backsights at each measurement.

1. Extend the line W-V.



Line W-V Extended

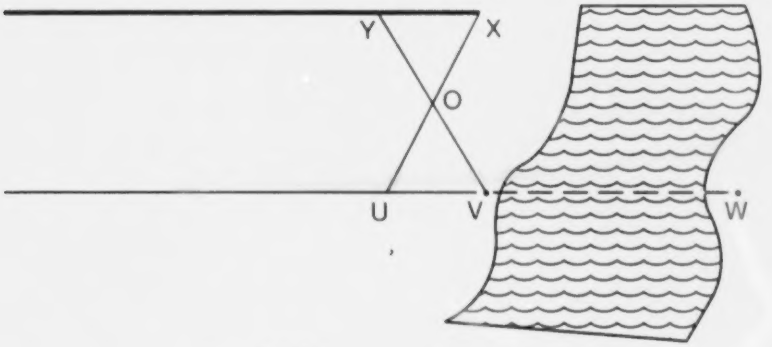
2. Set a point, O, at an angle, any distance from point V.
3. Measure the distance from V to O.
4. Continue to Y, measure the same V-O distance from O to Y, in a straight line, V-O-Y. Place a marker at Y.



Distance a = b
VO = OY

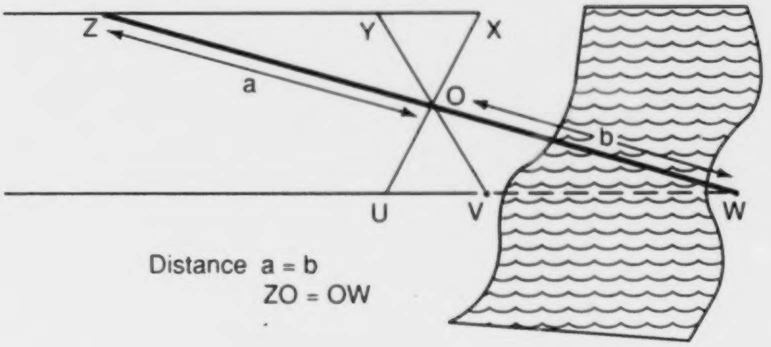
VOY

5. Set a line U-O the same distance as the line V-O. It should fall directly across from Y and have the same inside angle as the angle at point V. (See below)
6. Continue line U-O to point X. Where X crosses the same line as Y, the distance X-Y will be the same as the distance U-V. The angles will be the same for both triangles.
7. Set line Y-X and extend it.



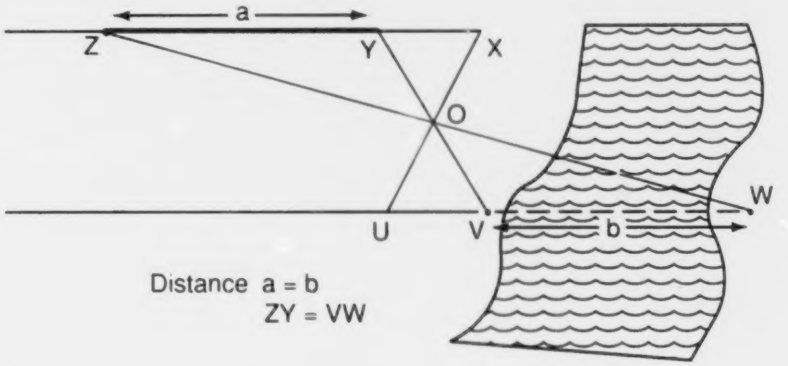
UOX

8. Set Z in line with O-W.


Z
Y
X
a
O
b
U
V
W
Distance a = b
ZO = OW

Z in line with O-W

9. Measure Z-Y as the distance equal to the distance of line V-W.


a
Z
Y
X
O
W
U
V
b
Distance a = b
ZY = VW

Z-Y = V-W

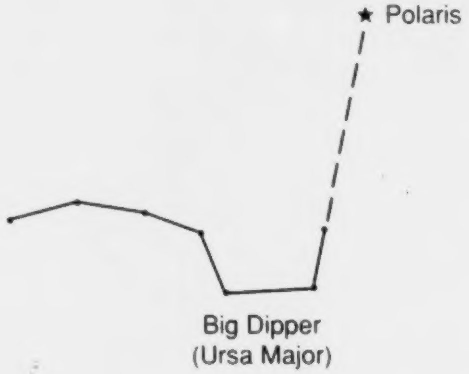
TAKE AN ANGLE READING ON POLARIS TO DETERMINE MAGNETIC DECLINATION

One way to get the magnetic declination for your area is to take an angle reading on Polaris to determine magnetic declination. When you have determined the declination, you can adjust your compass to true north.

You will need:

- A good compass graduated to 1° or 1/2°
- Paper and pencil or pen
- Flashlight
- Nonmetal platform such as a fencepost or plastic bucket

1. Locate an open place away from metal buildings and metal fencing.
2. Choose a clear, dark night when the moon is dark or when moonrise occurs well into the night.
3. Place the compass on the platform.
4. Locate the Big Dipper and Polaris. Look at the two stars that make up the outside of the bucket part of the Big Dipper. Follow the line of those two stars up in a straight line. Polaris is a medium-bright star on that same line.



5. Set the compass with the arrow on North and sight it on Polaris.
6. Read the compass.
7. The difference between your line of sight and the needle point is the declination.
8. Write down the declination.
9. Adjust your compass according to the procedure in Job Sheet 1.

OBJECTIVE 1

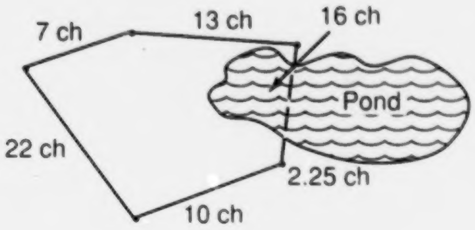
Match terms associated with surveying to their correct definitions.

- **Arbitrary**—Based on random or convenient choice
- **Backsight**—Compass reading made 180° from the foresight
- **Boundary line**—A line along which two areas meet

  NOTE: A line between private properties is usually called a property line.

- **Breaking the chain**—Using a part of the chain for a measurement

  EXAMPLE: At an obstacle or a turn in the boundary, the measurement is less than a full chain. Partial chains are always written as decimals, .5′ rather than 6".



Breaking the Chain

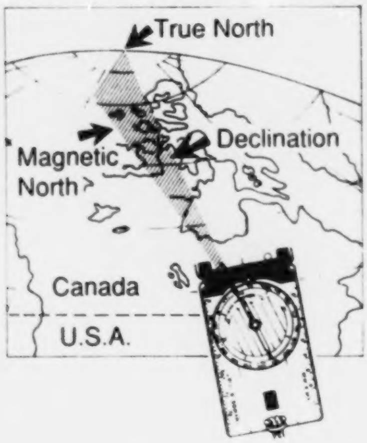
- **Chain**—A measurement of horizontal distance

  NOTE: Forest surveyors use a 66 foot chain because 66 divides evenly into the number of feet in a mile and in an acre; construction surveyors use a 100 ft chain.

- **Cruise**—A way to estimate the volume and value of timber on a tract

- **Declination**—The degree to which magnetic north varies from true north

  NOTE: The compass gives a reading of magnetic north. Magnetic north varies as much as 22° East in the continental U.S. and as much as 24° West. The correction in horizontal angle needed to convert magnetic readings to true readings is called the magnetic declination. (See Assignment Sheet 1 and Job Sheet 1 for ways to convert magnetic readings to true readings.)



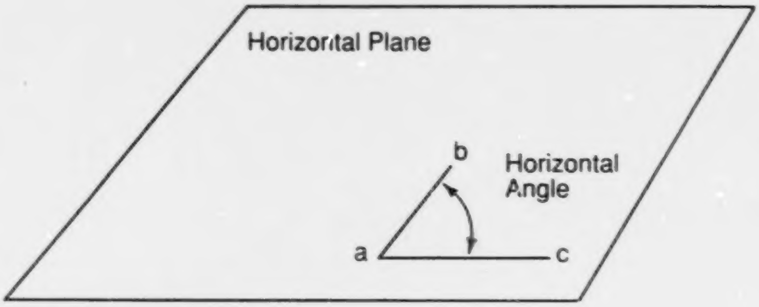
Declination

Courtesy of Silva Compass a division of Johnson's Camping, Inc., Binghamton, New York.

- **Foresight**—Compass reading made in a forward direction
- **Graduated**—Divided into measuring parts

  EXAMPLE: Inches, degrees, ounces (weight or liquid measures)

- **Horizontal angle**—The difference in direction where two horizontal lines meet



The horizontal angle where two section lines meet is 90°

Horizontal Angle

- **Horizontal distance**—A straight line measured over the ground

- **Magnetic north**—A geological direction caused by the earth's magnetism

  NOTE: Magnetic north changes slightly as the earth's crust changes.

- **Meridian**—An imaginary line running north and south through any given point on the earth's surface

  NOTE: There are 24 meridians running from pole to pole. They define the longitude of a place and also the time zones.

- **Surveying**—The science of measuring the earth's surface: distances, directions, and elevations; computing areas and volumes; and preparing maps of the measured area

- **Terrain**—The physical features of a tract of land

032

- **Trailer**—The portion of a surveying tape used to measure slope

  NOTE: Surveys measure horizontal distance. A slope is greater than the horizontal distance, so surveyors have to adjust the measure. Without the trailer, the adjustment would be made with trigonometry formulas. The trailer is graduated according to the formulas and, when used with an Abney hand level, no math is needed.

- **Traverse**—The measuring of an open or closed horizontal distance by a surveyor or survey team

- **True north**—The actual axis around which the earth spins

  NOTE: True north is directly below Polaris (the North Star) as viewed from the earth.

OBJECTIVE 2

Choose words or phrases to complete statements about why surveying is important in forestry.

- Growers must know how much timber they have for sale. The first step in estimating timber volume is the survey.

- The survey accomplishes the following objectives:

  - Measures how many acres of land are in a stand or on the property.

  - Marks forest tract boundaries.

  - Locates specific sites or landmarks.

  - Shows ownership boundaries.

- The information from the survey is used to draw a map and create a land description so the landowner, the forester, and the consultant have clear, agreed-upon information from which to make decisions and contracts.

- In addition to measuring the size of the timber stand, the survey team places markers at the boundaries so when the cruising team estimates volume, they will know which areas to include.

- How accurate the survey has to be depends on the value of the timber and the size of the area to be surveyed.

  EXAMPLE: A large area of 400 acres of big timber may require a very accurate survey and a map. For an oddly-shaped stand of about 50 acres, the landowner may want a survey that will have clearly-marked boundaries, but does not have to be as accurate.

OBJECTIVE 3 **Select from a list characteristics of a forest survey.**

- Most forest surveying is done to estimate the amount of timber in a certain area. By knowing the size of the area, and then the number and size of trees, the forester can estimate the value of the stand. The exact procedures will vary according to the employer's policies, the way the team members work together, and the conditions on a particular job. The surveyors use different techniques in brush and in wooded areas than on cleared land or along fencelines.

- There are two methods of measuring a horizontal distance, pacing and chaining, also called taping. Pacing is not an accurate measure, but is used for rough estimates. Chaining is the most accurate method commonly used.

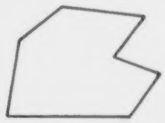
- Corners and horizontal angles are measured with a compass. Slopes are measured with an Abney hand level (See Objective 4).

- Forest surveying is different from other types of surveying. Where construction surveyors use 100 feet, 200 feet or 300 feet measurements, most foresters use a 66 foot measure, called a chain.

- There are two members of the survey team, the head chain person and the rear chain person. Both carry compasses. One carries field notes to record measurements, the other usually carries the markers.

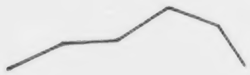
- If they are measuring a timber stand, they make a *closed traverse*, returning to the starting point.

  NOTE: The U.S. Forest Service has set standards for the amount of error allowed in the survey. It takes experience and careful measurements to stay within standards.



Closed Traverse

- If the team is looking for a certain point, a certain location or marker, they make an *open traverse*, marking and recording their movement toward the end point.



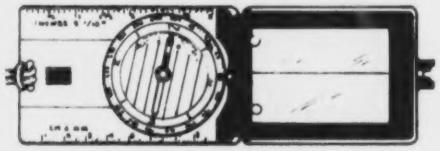
Open Traverse

OBJECTIVE 4

Match surveying tools to their descriptions.
(Activity Sheets 1, 3, and 4)

- **Compass**—Used to measure the magnetic bearing of a line or to run a reasonably straight line through the woods (See Objective 5)

  NOTE: The compass can be hand carried or mounted on a tripod or staff. The tripod or staff is more accurate because it holds the compass steady.

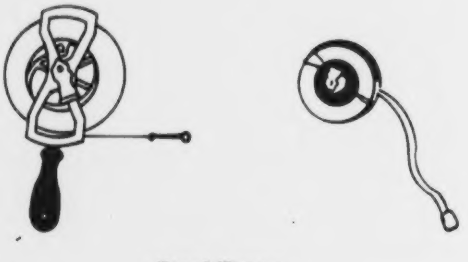


Hand Compass

Staff Compass

- **Steel tape**—1- or 2-chain measure graduated in links; may have a trailer; usually comes on a reel (See Objective 10)

  NOTE: The steel tape is usually 132 feet, but comes in 3- and 5-chain lengths. It usually is marked with a trailer. Tapes with the same graduations are also made of plastic or fiberglass. The last link is usually graduated in tenths for partial, or *fractional*, measurements.



Steel Tapes

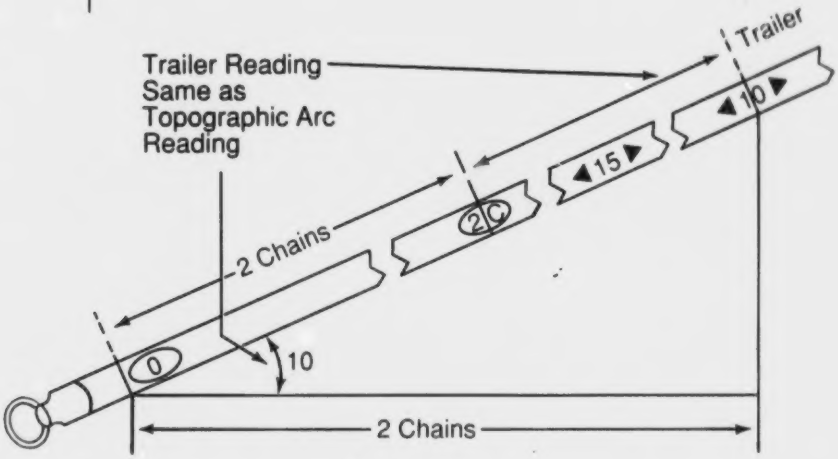
- **Engineer's tape**—Tapes are 100 feet long with links of 1 foot each; available in 100, 200 and 300 foot lengths; can be metal, plastic or fiberglass

  NOTE: The Engineer's tape comes on a reel and will look like a steel tape, except for the 1-foot graduations.

- **Rope chain**—1- or 2-chain plastic-coated measure with color-coded links, chains and trailer; chains are 66 feet

- **Slope chain**—A surveyor's tape with a trailer

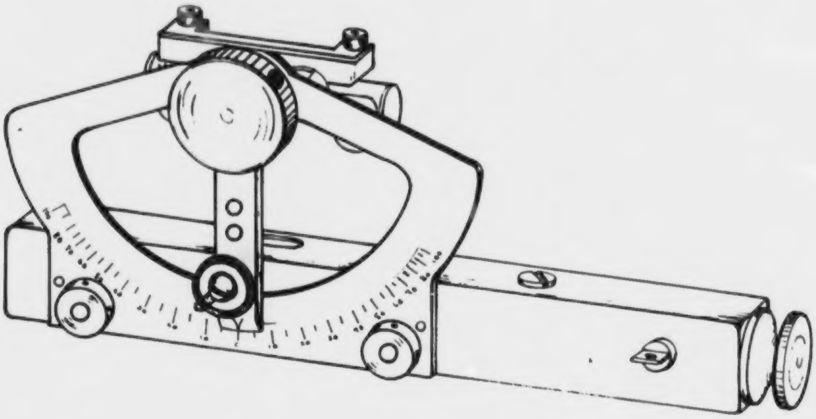
  NOTE: The slope graduations are on the underside of a steel tape. A 2-chain measure may have trailers after the first and the second chain.


Trailer
Trailer Reading Same as Topographic Arc Reading
2 Chains
0
2C
15
10
10
2 Chains

Slope Chain

- **Abney hand level**—Used with the slope tape; measures the angle between the horizontal plane and the line of sight along a slope

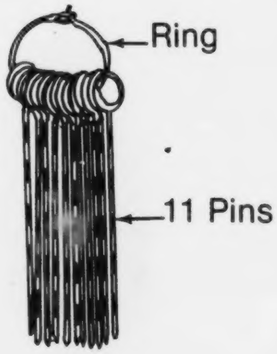
  NOTE: The Abney level has a scale that directly corresponds to the graduations on the slope tape. It can be used for both high places and low spots. (See Activity Sheet 4 and Job Sheet 7)



Abney Hand Level

- **Chaining pins**—Used to mark out chain lengths or shorter lengths while measuring a longer distance

  NOTE: Chaining pins are also called surveyor's arrows, tally pins, or taping pins. They are 14-18 inches long and usually painted red and white. There are 11 pins on a ring.



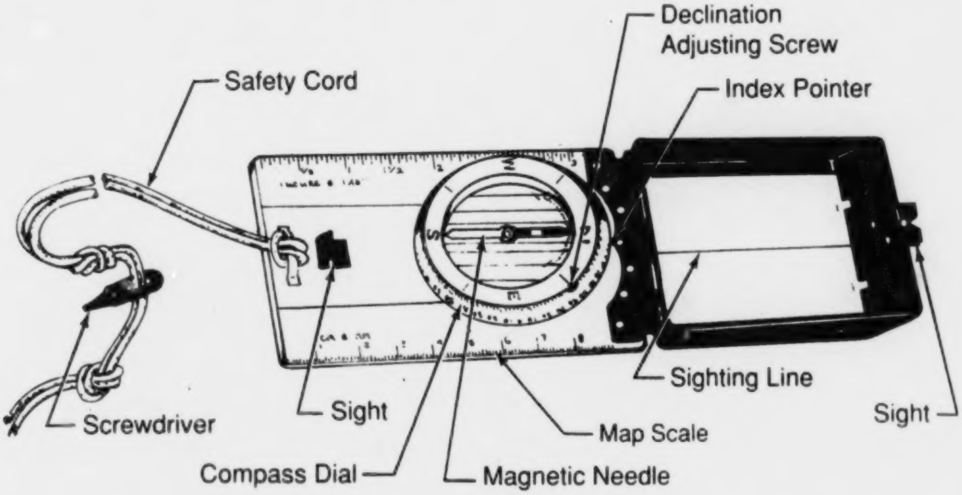
Chaining Pins

- **Flags**—Brightly colored tape, usually dayglow orange, tied onto branches or wooden stakes as markers

OBJECTIVE 5

Label parts of a compass. (Activity Sheet 1, Job Sheet 1)

NOTE: Compasses are made in a range of designs, from simple models costing only a few dollars to models with hi-tech magnetics, engineering, and materials, having a built-in level and clinometer and a price tag of well over a hundred dollars.


Declination Adjusting Screw
Safety Cord
Index Pointer
Sighting Line
Sight
Screwdriver
Sight
Map Scale
Compass Dial
Magnetic Needle

Parts Of A Compass

OBJECTIVE 6

Match compass measurements to their values and symbols.

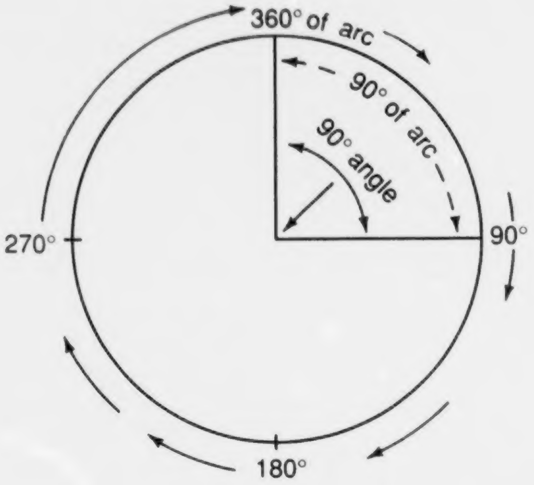
- Compass readings are measured in degrees (°), minutes (′) and seconds (") of arc
- There are 360 degrees in a full circle, 60 minutes in 1 degree, and 60 seconds in 1 minute

NOTE: Most compasses are calibrated in 2° increments and don't show minutes and seconds on the face.

Full circle = 360 degrees
1 degree = 60 minutes
1 minute = 60 seconds

- The symbol for degrees is °

  EXAMPLE: Below is a 90° angle and 90° of arc


360° of arc
90° of arc
90° angle
270°
90°
180°

90° Angle

- The symbol for minutes is ′

  EXAMPLE: 89°59′—one minute short of 90°

- The symbol for seconds is ″

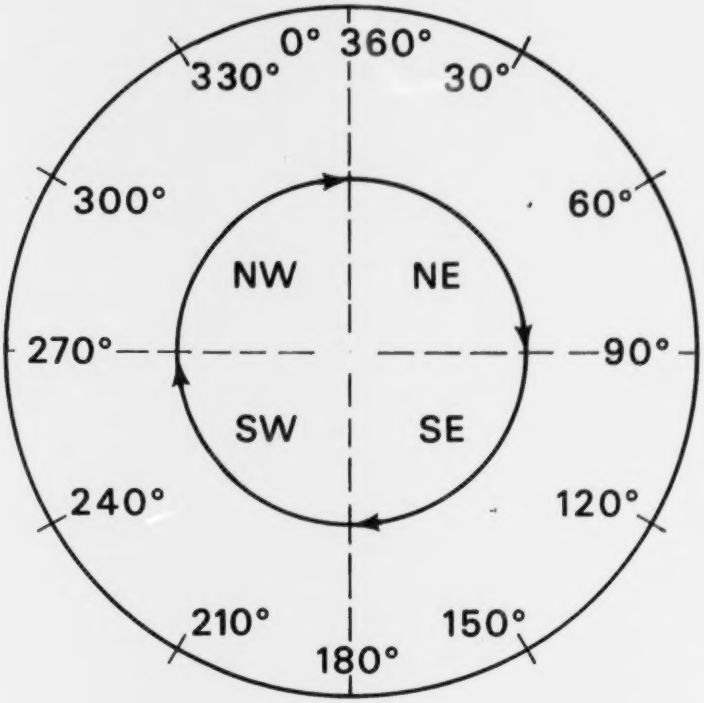
  EXAMPLE: 89°59′59″—one second short of 90°

  Full circle = 360°
  1° = 60′
  1′ = 60″

OBJECTIVE 7

Distinguish between azimuths and bearings.

- **Azimuth**—A horizontal angle measured clockwise from 0° to 360° on a compass.



Azimuth Markings

The azimuth direction:

- Is measured in degrees, minutes, and seconds
- Requires only a numerical value

  EXAMPLES: Azimuth 144°51′
- The reference meridian is usually north

  NOTE: The south meridian is used in special conditions and will be noted Azimuth (S) or AzS. The type of meridian system used defines the type of azimuth used.

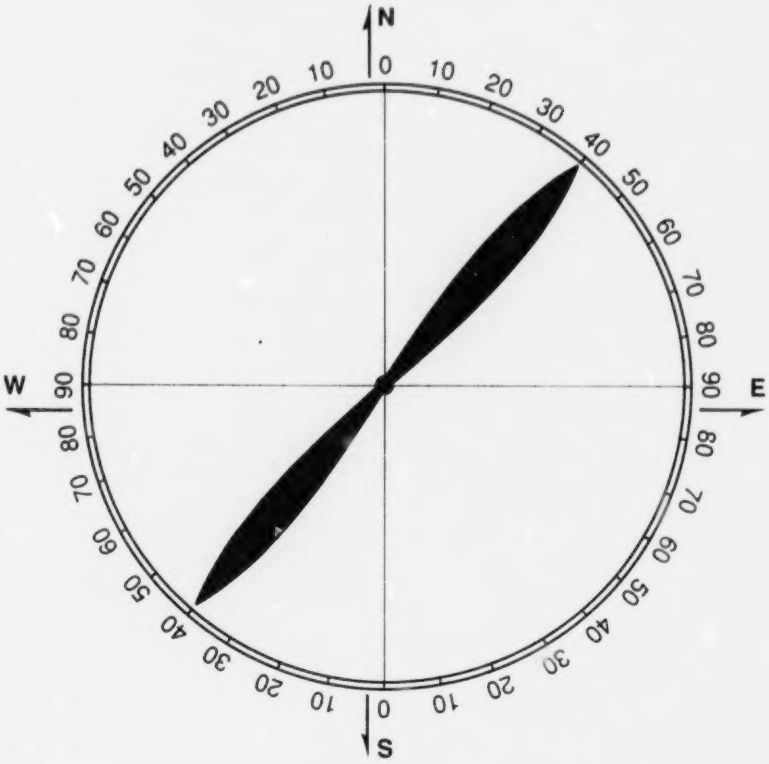
003

- **Bearing**—A horizontal angle measured in 90° quadrants on the compass. (See figure below)

  Bearing direction:

  – Is measured from the north or south end of a meridian

  – To determine which side of the meridian the bearing goes, an east or west is added



N 40°E (reverse) S40°W

Bearing Of A Line

  – Is measured either clockwise or counterclockwise

  – The range is from 0° to 90° and can **never** be greater than 90°

  – Is measured in degrees, minutes, and seconds

C91

OBJECTIVE 8

Choose the best word or phrase to complete statements about pacing. (Job Sheets 2 and 3)

NOTE: Pacing is one of the least accurate ways of measuring, because everybody's step is different. Still, it's a good tool for surveying and timber cruising.

- Pace—Two natural steps, used to measure short distances.
- Pacing downhill or uphill will alter the length of the step.
- Pacing is particularly useful when looking for survey markers, marking rough measurements, detecting blunders, and checking measurements.
- You must measure your pace on the same type of terrain you will be surveying.
- There are two methods of pacing:
  - Count every step
  - Count every time the left (or right) foot hits the ground

OBJECTIVE 9

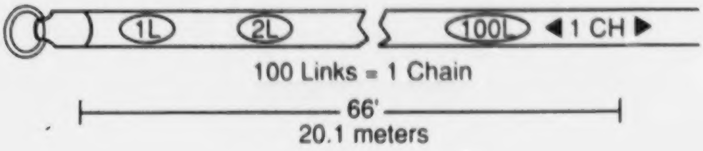
Convert chaining measurements. (Transparency Master 2)

NOTE: In the United States, measurements are in feet and decimal parts of a foot, never in inches. Metric measures are used in other places in the world and are slowly coming into use in the United States.

- Chain—66 foot horizontal measure = about 20 meters

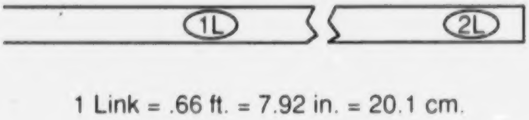
  NOTE: Distances on all U.S. Government Land Surveys are measured in chains and links. Forest surveyors use a special 66 foot chain, called a Gunter's chain. Englishman Edmund Gunter invented it as the standard surveying chain in 1620 and it was used for all surveys until the late 1900s. Although modern surveyors other than foresters use a 100 foot chain, foresters still use Gunter's because it's easy to convert the 66 chains to acres and miles. Today, steel tapes are marked with chains, and are called chains, but a real "chain" isn't used at all. The act of measuring with a steel tape is called "chaining."

- 1 chain has 100 links = 20.1 meters (1 chain on the steel tape is marked in 100 links)


1L
2L
100L
1 CH
100 Links = 1 Chain
66'
20.1 meters

100 Links

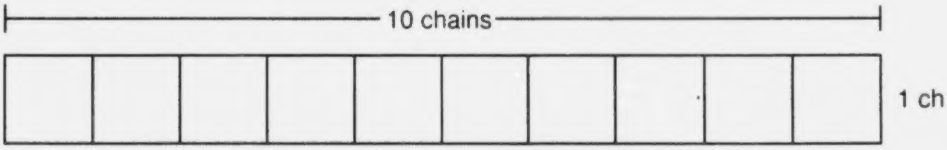
- 1 link = .66 feet = 7.92 inches = 20.1 centimeters


1L
2L
1 Link = .66 ft. = 7.92 in. = 20.1 cm.

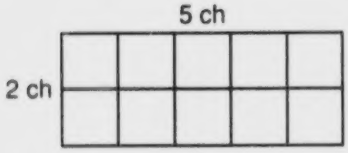
1 Link

- 80 chains = 1 mile
- 47.9 chains = 1 kilometer
- 10 square chains = 1 acre = 43,560 square feet

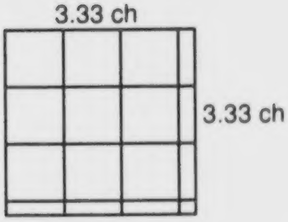
  NOTE: An acre is 1/8 mile long and 1/80 mile wide, or 660 feet long and 66 feet wide. So, using chains, an acre would be 10 chains long and 1 chain wide.


10 chains
1 ch

10 X 1 Chains



2 x 5 chains



3.33 x 3.33

- Pole or rod = 1/4 of a chain = 16.5 feet = 5 meters

  NOTE: The term "pole" comes from a perch pole in an English chicken house.

OBJECTIVE 10

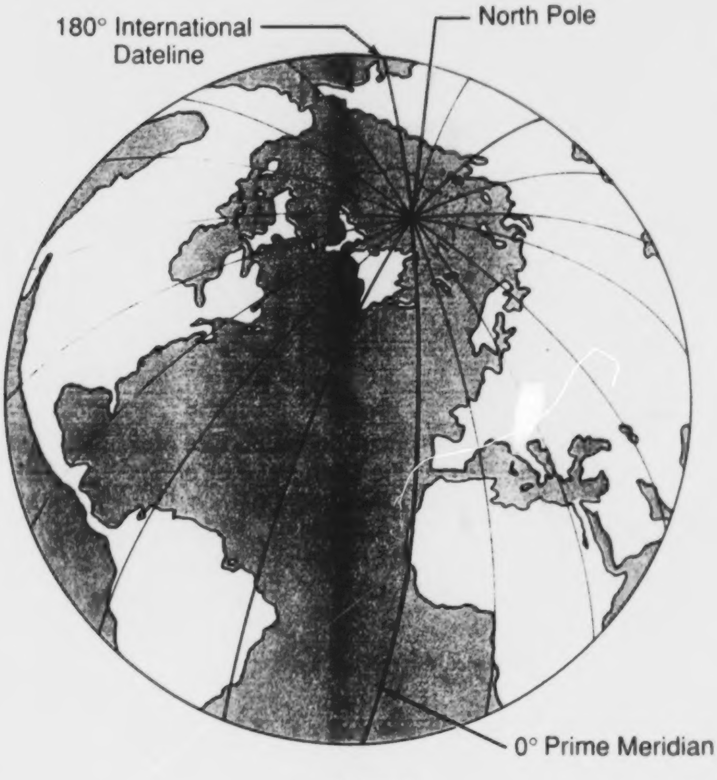
Distinguish between survey team members' tasks.

- **Rear chain person**
  - Keeps the head chain person aligned toward the station with a compass
  - Holds the tape precisely over the rear mark
  - Calls out "chain" or "mark" when in position
  - Picks up chain pins
  - Keeps count of all full tape lengths and records them
  - Maintains care and storage of equipment
- **Head chain person**
  - Carries the tape or chain forward along the compass line, being careful there are no loops
  - Prepares the ground surface for the mark
  - Applies proper tension, checking that the tape is horizontal
  - Places all chaining marks or pins, calling out "chained" or "marked"
  - Records measurements
  - Supervises the survey work in progress

MERIDIANS AND THE EARTH'S MAGNETISM

- A **true meridian** is an imaginary line (a half-circle) going north and south, from pole to pole, on the surface of the earth. A true meridian is also called a geographic meridian because it passes through the actual poles. It is determined by taking compass readings on Polaris (the North Star, which is directly over the North Pole) or on the sun. The true meridians are permanent and don't change. True meridians are longitudinal lines and are used to divide time zones around the world.

  EXAMPLES: The Prime Meridian is at 0° longitude and passes through Greenwich, England. The opposite meridian, at 180° longitude, is the International Date Line. The 100° meridian passes through N. Dakota, S. Dakota, Nebraska, Kansas, the Oklahoma panhandle, and Texas.



Meridians

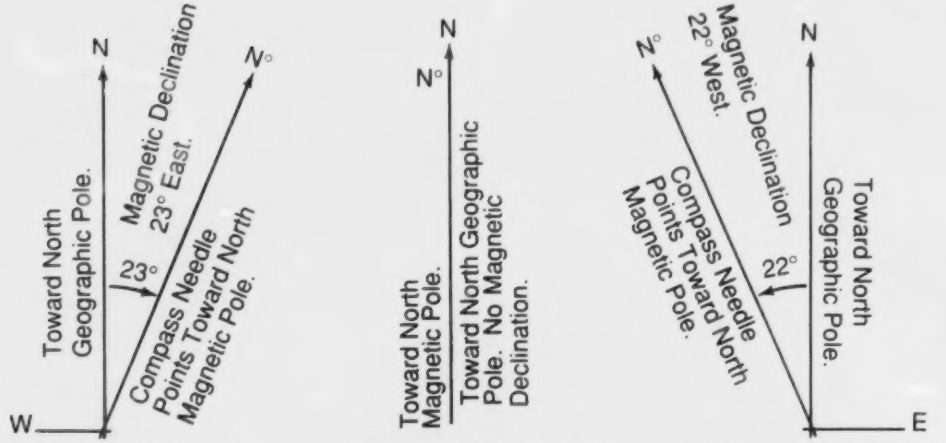
C03

- A **magnetic meridian** is also a north-south line, but it doesn't pass through the actual north and south poles. The earth is a large magnet, having magnetic poles that are different from the geographic poles. All the magnetic meridians pass through the magnetic poles just as the true meridians pass through the geographic poles. Since the needle of a compass is magnetized, it is attracted by these magnetic poles and points in their direction.

- The magnetic poles shift slightly from day to day and from year to year. Over the years, the variation, called the **magnetic declination**, changes quite a bit.

NOTE: The north magnetic pole is located northwest of Hudson Bay.

The United States Coast and Geodetic Survey publish maps showing the declination. The map divides the country into **isogonic lines**, imaginary lines on the earth's surface, passing through those points having the same magnetic declination at any given time. At all points on an isogonic line, the compass needle makes the same angle with the true meridian.


N
Magnetic Declination 23° East.
N°
Toward North Geographic Pole.
23°
Compass Needle Points Toward North Magnetic Pole.
W
N
N°
Toward North Magnetic Pole.
Toward North Geographic Pole. No Magnetic Declination.
N°
Magnetic Declination 22° West.
N
Compass Needle Points Toward North Magnetic Pole.
22°
Toward North Geographic Pole.
E

Point on the Surface of the Earth Somewhere in the State of Washington.

Point on the Surface of the Earth just East of Cincinnati, Ohio.

Point on the Surface of the Earth Somewhere in Maine.

Isogonic Angles

Source: Surveyor 3 & 2

A line where there is no declination, runs through the U.S. cities of Cincinnati, Ohio and Savannah, Georgia. See Supplement 1.

All points EAST of this line have a WESTERN declination

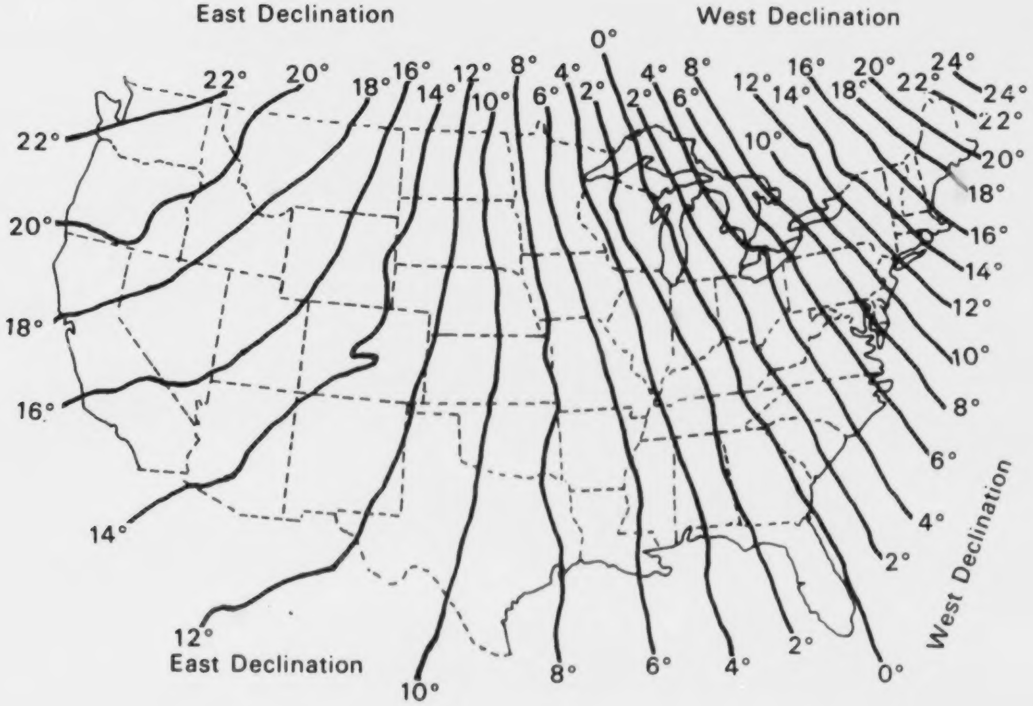
All points WEST of this line have an EASTERN declination

See the Isogonic Map in Supplement 2.

- Surveyors take their readings with a compass. But the compass points to the shifting magnetic pole and the declination at different locations means that compass readings are not the same in all places. So, surveyors change magnetic readings to true readings, which are permanent and the same the world over.

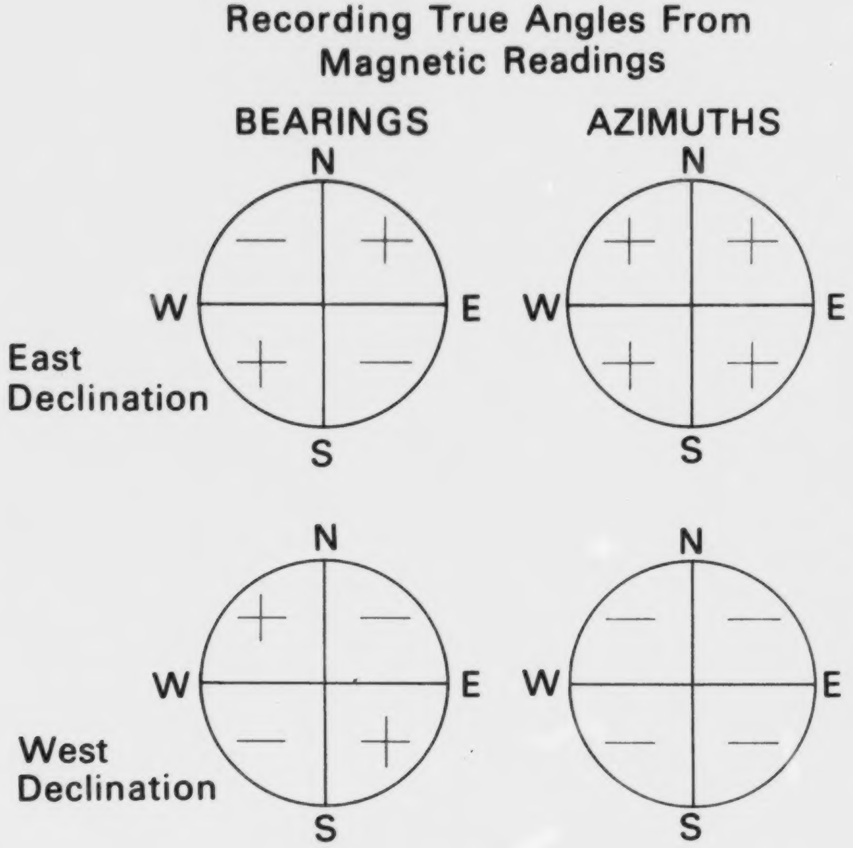
  NOTE: For the purpose of a survey, surveyors can use any north-south fixed line of reference, called an *assumed meridian*. For the purpose of a particular survey, for example, the surveyors may use a road as the assumed meridian.

ISOGONIC CHART


East Declination
West Declination
0°
22°
20°
18°
16°
14°
12°
8°
10°
4°
6°
2°
2°
4°
6°
8°
12°
14°
16°
18°
20°
22°
24°
24°
22°
20°
18°
16°
14°
12°
10°
8°
6°
4°
2°
22°
20°
18°
16°
14°
12°
East Declination
10°
8°
6°
4°
2°
0°
West Declination

Source: Coast and Geodetic Survey, U.S. Department of Commerce.

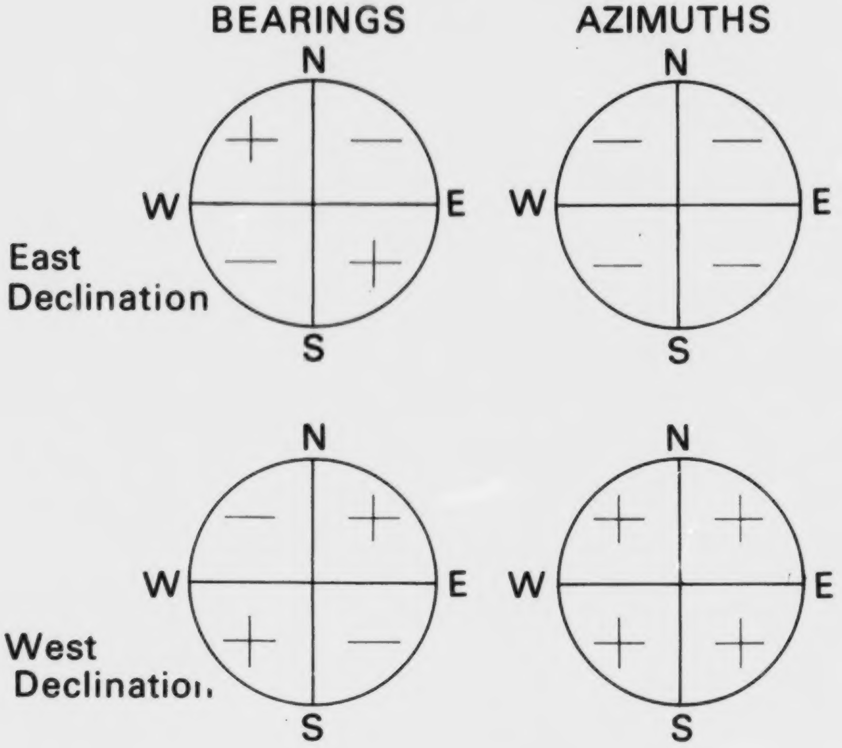
ANGLE CORRECTIONS



Recording True Angles From Magnetic Readings

BEARINGS
AZIMUTHS
N
W
E
S
East Declination
−
+
+
−
N
W
E
S
+
+
+
+
N
W
E
S
West Declination
+
−
−
+
N
W
E
S
−
−
−
−

Reading Magnetic Angles For True Directions


BEARINGS
AZIMUTHS
N
W
E
S
+
−
East Declination
West Declination

COMMON ERRORS IN CHAINING OR TAPING

- Bad alignment—off the course
- Letting the tape sag instead of holding it taut and level
- Adding or dropping a full tape length
- Adding or dropping a foot or a link when breaking the chain
- Transposing or reading wrong numbers

  EXAMPLE: Reading 42.23 for 42.32 or
  79 for 97
- Using the compass in the presence of metal:
  - Fencelines
  - Nails
  - Metal wristwatches
  - Metal pencils or pens – or the metal eraser holders on wood pencils
  - Metal buildings
  - Rings
  - Metal buttons on raingear or shirts
  - Eyeglasses
  - Metal safety helments

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FIELD NOTES

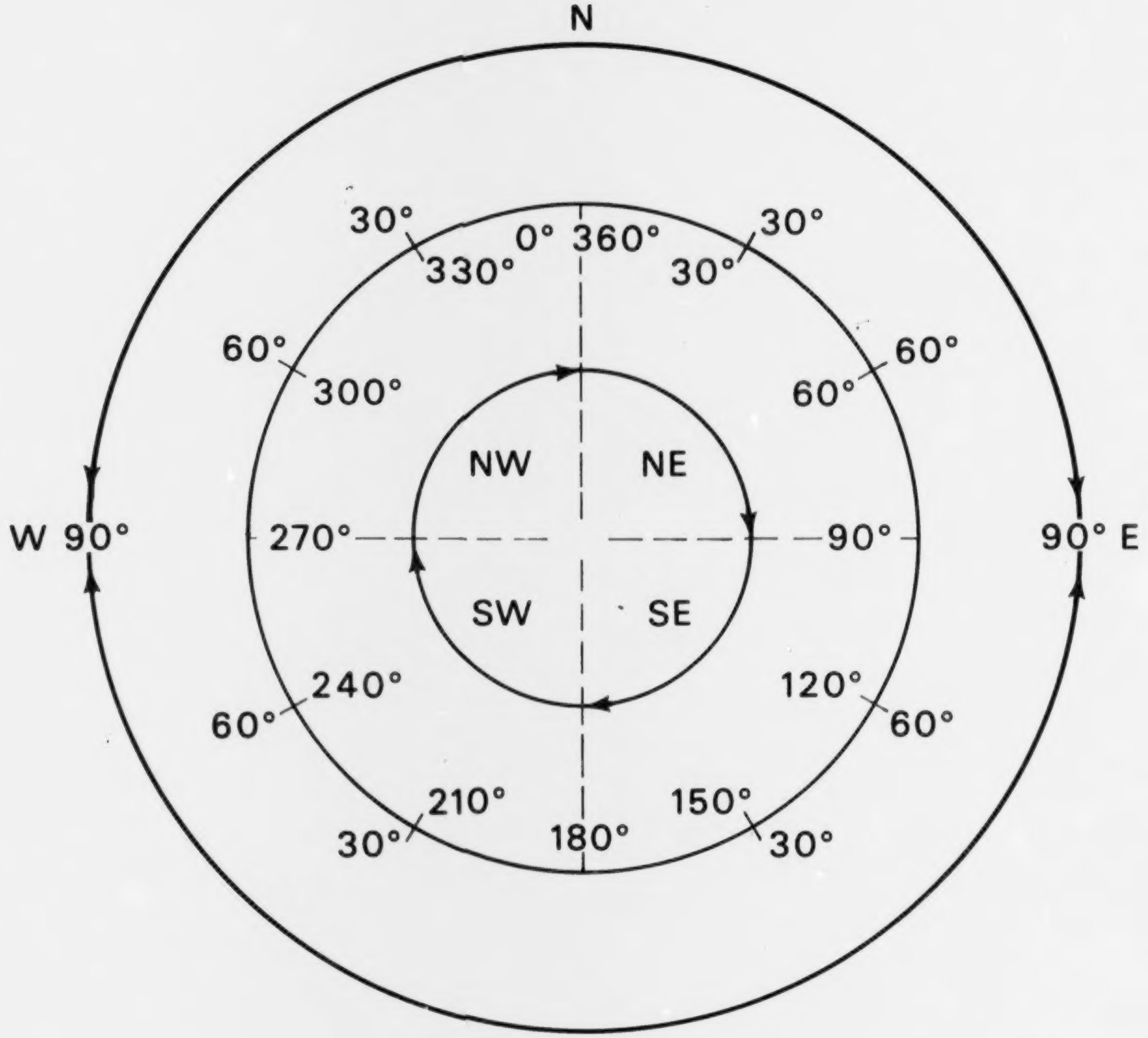
In field and construction surveying, surveyors use different types of field notes for different survey assignments. They have standard symbols and their notes are legal documents. Foresters, however, don't have standardized forms or symbols and may take notes according to personal preference.

Notes must include the basic information: The azimuth readings, foresights and backsights, and distance for each marker, slope angles, and any other important information.

Boundary Survey
Scale: 1" = 100'

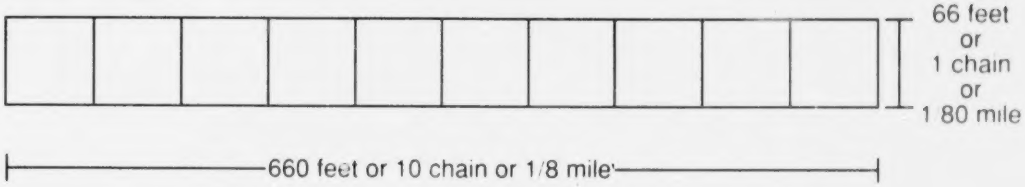
Station	Horiz. Dist.	Foresight Bearing	Backsight Bearing	Interior Angle	Correction Bearing

Compass With Azimuths And Bearings


N
30°
330°
0° 360°
30°
30°
60°
300°
60°
60°
NW
NE
W 90°
270°
90°
90° E
SW
SE
240°
60°
120°
60°
210°
30°
180°
150°
30°

AZIMUTH - INSIDE CIRCLE
BEARING - OUTSIDE CIRCLE

One Acre /1 Mile Chaining


66 feet
or
1 chain
or
1/80 mile
660 feet or 10 chain or 1/8 mile

one acre = 660 x 60
or
43,560 sq. feet
or
10 sq. chains

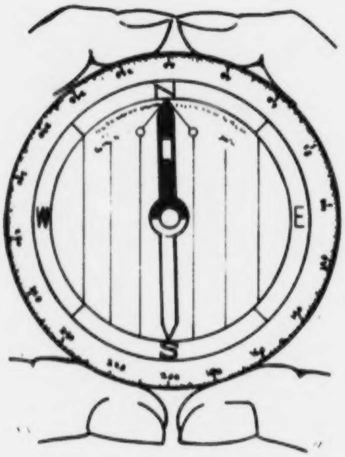
one mile = 80 chains

COMPASS REVIEW

HOW TO USE THE COMPASS

REMEMBER: Remove any metal from your body and move away from any metal fences, buildings, vehicles, etc.

1. Hold the compass level. When you are first learning to use the compass, put it between your thumbs and your two forefingers like this:



2. If the compass has sights, align them according to manufacturer's instructions.
3. Turn the rotating dial, checking to see that the magnetic needle swings freely.

4. Let the magnetic needle settle before reading the direction.
   a. When the needle comes to a stop, the dark end will be pointing north.
   b. Turn the compass or the rotating dial carefully, keeping the needle in the same position, until the N on the face of the compass is under the needle.

   This is called "orienting or setting the compass."

5. Keep the compass "set" in this position as you (a) find the direction of an object or (b) determine the direction of travel.
   a. Find the direction of an object.
      (1) Set the compass.
      (2) "Sight" or point the sighting line toward an object whose direction is not known.
      (3 Turn the rotating dial until it is lined up with the sight line.
      (4) Read the compass.
   b. Determine the direction of travel.
      (1) Hold the compass level in front of you.
      (2) Set the compass.
      (3) Locate on the dial the reading you want to follow, such as Az 225° or S45°W.
      (4) Turn the dial so the reading you want is aligned with the sight line.
      (5) Choose a tall object along your line as your reference point.
      (6) Walk straight toward the object.
      (7) When you reach the object, repeat steps 5 and 6 until you reach your destination.

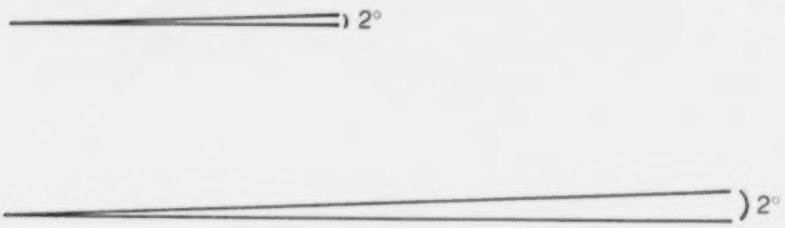
   If you don't have a rotating dial, turn the compass so the reading you want is right in front of you. Turn your body in that direction, keeping the compass level and the reading directly in front of you. Keep looking at the compass. Stop when the needle goes to N again. Look up *without turning your head.* The compass reading is straight ahead of you. Follow steps 5 and 6.

HOW TO TAKE THE BACKSIGHT

1. Set the compass.
2. Turn around until you are facing the last marker.
3. With the needle pointing North, read the compass.
4. Record the reading.
5. If your sighting is not 180° from the foresight, write down the difference.

The policy for error is set by the employer. Over short distances or several hundred feet, a few degrees won't make much difference. Over a distance of miles, however, the few degrees will add up. An error of 1° will make a difference of 92 feet over a mile.

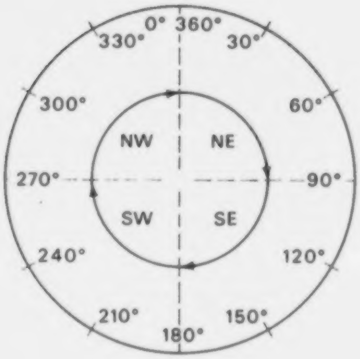
See the difference in an error of a 2° angle just on this page:



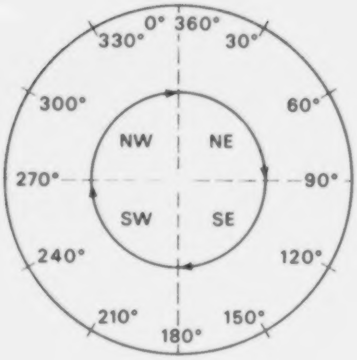
Error Of A Few Degrees

LOCATE AZIMUTHS ON A COMPASS FACE

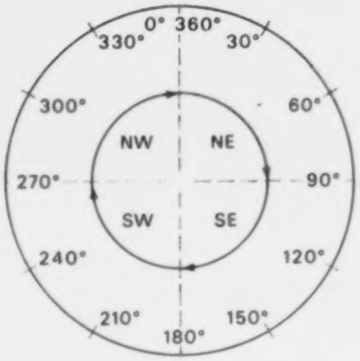
Locate azimuths on a compass face. Draw the compass needle in the correct place for each of the readings below.


0°
360°
330°
30°
300°
60°
NW
NE
270°
90°
SW
SE
240°
120°
210°
150°
180°

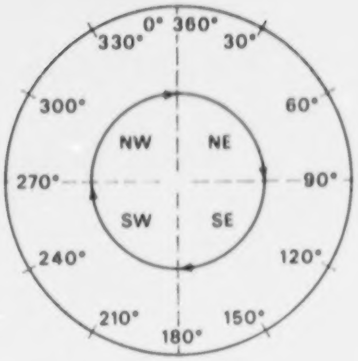
Az 316°


0°
360°
330°
30°
300°
60°
NW
NE
270°
90°
SW
SE
240°
120°
210°
150°
180°

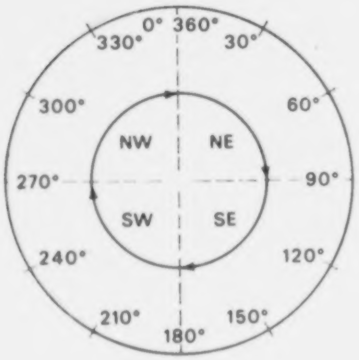
Az 22°


0°
360°
330°
30°
300°
60°
NW
NE
270°
90°
SW
SE
240°
120°
210°
150°
180°

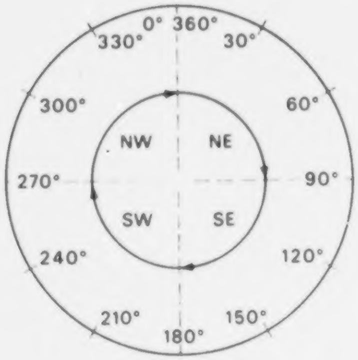
Az 118°


0°
360°
330°
30°
300°
60°
NW
NE
270°
90°
SW
SE
240°
120°
210°
150°
180°

Az 222°


0°
360°
330°
30°
300°
60°
NW
NE
270°
90°
SW
SE
240°
120°
210°
150°
180°

Az 180°


0°
360°
330°
30°
300°
60°
NW
NE
270°
90°
SW
SE
240°
120°
210°
150°
180°

Az 118°

MEASURE CHAINS AND CALCULATE DISTANCE

Sixty–six feet is an unusual measure of distance. Use the steel tape to learn what chains and links really stand for as distances and numbers. Use the information in Objective 9 to help you.

Part 1

- Get a partner.
- Take the tape outside and measure 1 chain.
- Look at the endpoint.
- Walk the length of the chain. Look at the starting point. Walk back to the starting point.
- Turn in a different direction from the same starting point and stop when you think you've covered 66 feet. Have your partner measure your distance.
- Trade jobs.
- Do this four times, until you both are within two feet of a chain.

Part 2

- Get a partner.
- Get a pencil and paper and a steel tape.
- Pick an area to measure: school classroom, courtyard, or other area.
- Estimate how many chains you'll end up with, write down both people's guesses.
- Decide who will take the notes.
- Measure the area.
- The person who has the least accurate estimate rolls up the chain.

- Return to your class. Using the measurement you determined in Part 2, work these problems, then compare your answers with your partner's answers.

  1. How many chains?
  2. How many feet?
  3. How many meters?
  4. How many links?
  5. How many inches?
  6. How many centimeters?
  7. How many rods?
  8. How many more chains (or how many fewer chains) would it take to make 1/8 mile?

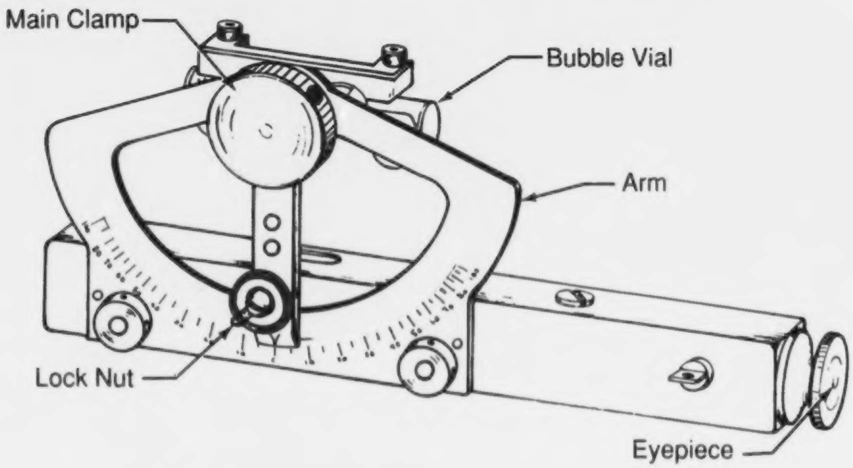
BONUS: For the distance you measured, what is the decimal fraction of a mile?

HOW TO USE THE ABNEY HAND LEVEL TO CHAIN A SLOPE

The Abney is a tool that can do many jobs. It is used to measure the height of trees, to find the percent of grade, to find degrees and minutes in the angle of a slope, to measure the rise or fall of a slope in a 66 foot chain.

The objective in surveying is to measure the *horizontal distance*. On a slope, the slope distance is greater than the horizontal distance, but it has to be measured as a horizontal distance. The difference can be obtained by using an Abney hand level and a trailer. The trailer is graduated into sections to correct the slope distance to the horizontal distance directly from the Abney reading.

IMPORTANT! The Abney topographic scale reads *direct at one chain of 66 feet*. This means in 66 feet, the reading will be in feet. So if you have measured 1 chain and the reading is 20, then the rise is equal to 20 feet of horizontal distance.



Parts Of An Abney Hand Level

TO READ THE TOPOGRAPHIC SCALE

1. Check that the topographic scale is visible.
2. Check that the main clamp is loose enough that the arm moves easily.
3. Turn the lock nut to set the needle on zero.
4. Identify an object higher or lower than eye level.
5. Hold the eye piece up to your eye and tilt the Abney until you have the object in the sight.
6. Adjust the angle until the crossline is directly on the object.
7. Turn the lock nut forward or backward until the bubble is on the crosshair.
8. Slowly and carefully turn the lock nut until the bubble is on the crosshair.
9. Lower the Abney and read the topographic scale.

   CAUTION: Be sure to read the *topographic* scale. Beginning surveyors often make the mistake of reading the wrong scale.

ASSIGNMENT SHEET 1

USE BASIC SURVEYING TECHNIQUES

X

NAME ______________________________ SCORE ________

OBJECTIVE 11

Use an isogonic chart to correct magnetic readings to true readings.

INTRODUCTION

Review Supplements 1 and 2 about meridians and the earth's magnetic field. Wherever you are working as a forester, you can use the chart to find the approximate declination in your area, or you can contact your local U.S. Geological Survey office to find the exact declination.

DIRECTIONS

1. Refer to the isogonic chart in Supplement 2, and find the declination for your area.
2. - If the declination for your area is 10° east, add 10° to the azimuth.
   - If the declination for your area is 10° west, subtract 10° from the azimuth.

ADD For 10° East Magnetic Declination		SUBTRACT For 10° West Magnetic Declination	
Magnetic reading	True reading	Magnetic reading	True reading
AZ 24°	34°	24°	14°

If you are in the field, you will record the magnetic reading, the isogonic correction and the true reading. If your compass has a magnetic declination screw, you can adjust the compass to give a corrected reading. (See Job Sheet 1)

Use Supplement 1, the isogonic chart of the United States, to answer the questions below.

1. What is the magnetic declination for your area? ___________

2. Write the true azimuths for the following magnetic readings using these magnetic declinations.

	4°E	12°W	Declination for your area
a. 47°			
b. 262°			
c. 354°			

Write the correct letter in the blank.

3. A city with a declination of 14°E is ____________________.
   - a. Kansas City, Kansas
   - b. New York, New York
   - c. Denver, Colorado
4. A city with a declination of 8°W is ____________________.
   - a. Chicago, Illinois
   - b. Washington, D.C.
   - c. Houston, Texas

ASSIGNMENT ANSWERS

USE BASIC SURVEYING TECHNIQUES

X

ASSIGNMENT SHEET 1

1. Check that the answer is the correct declination for your locale.

2.

	4°E	12°W	Declination for your area
a.	51°	35°	
b.	266°	250°	
c.	358°	342°	

3. c

4. b

JOB SHEET 1 — USE BASIC SURVEYING TECHNIQUES

OBJECTIVE 12a

Adjust the compass to true readings.

TOOLS AND MATERIALS

- Compass with magnetic declination adjustment
- Field book or pad
- Pen or pencil
- Isogonic chart (Supplement 2)

PROCEDURE

1. Take an azimuth.
2. Record it in field book or notes.
3. Refer to the isogonic chart and find the declination for your area.
4. Calculate the true reading.
5. Record the true reading.
6. Adjust the compass:
    a. Set the needle at North.
    b. Locate the declination adjusting screw.
    c. Pick up the screwdriver attached to the compass.
    d. Use the screwdriver to turn the screw in the direction of true north.
    e. Adjust the screw until the magnetic needle points to the correct degree for the true reading.
    f. Replace screwdriver in proper place.
    g. Rotate the compass dial to set the magnetic needle at North.
7. Have your instructor check the reading.
8. Record the corrected reading.
9. Put away tools.

JOB SHEET 2 — USE BASIC SURVEYING TECHNIQUES — X

OBJECTIVE 12b

Determine the length of your pace.

TOOLS, MATERIALS AND PERSONNEL

- Tape or chain
- Flag tape, chaining pins or other marker
- Field book or note pad
- Pen or pencil
- Head chain person

PROCEDURE

Part 1 – Determine the length of your step.

1. Measure and mark a straight, level course 100 feet long with a marker at each end.
2. Place the toe of your foot even and just to the side of the starting marker.
3. Using a normal walking step, walk straight toward the end.

   NOTE: Walk at a normal speed, not too fast, not too slow.

4. Count your steps as you go.
5. At the end write down the total number of paces, including any partial step.
6. Record your steps as follows:

Pass	Length	Paces
1	100 ft	________
2	100 ft	________
3	100 ft	________
4	100 ft	________

7. Turn back toward start: with the toe even and just to the side of the end and repeat the above procedure.
8. Repeat steps 2–6, making a total of 4 passes.
9. Add the totals and divide the total footage by the total number of steps to determine the length of step.

9. Add the totals and divide the total footage by the total number of steps to determine the length of step.

EXAMPLE:

Pass	Length	Paces
1	100 ft	38.0
2	100 ft	37.0
3	100 ft	39.0
4	100 ft	36.0
5	100 ft	36.5
Totals	500 ft	186.5

$$186\overline{)500.00} = 2.688 = 2.69$$ feet per step

NOTE: Remember, the answer has to be in decimals.

The average length of your step is _____ feet

10. Divide 66 by the length of your step:

Number of your steps in a chain ______________

NOTE: Remember, the length of your step will change on rough terrain or on slopes. Use these procedures to find the length of your step on the ground you will be surveying.

11. Have your instructor check your work.

JOB SHEET 3

USE BASIC SURVEYING TECHNIQUES

X

OBJECTIVE 12c

Pace unknown distances.

TOOLS AND MATERIALS

- Marked areas
- Pencil/pen

Your instructor will designate three areas such as a hallway, parking lot, grassy area, etc.

PROCEDURE

1. Pace off the distances for each section and record them below.

   Area 1 ______________________________

   Area 2 ______________________________

   Area 3 ______________________________

2. Have your instructor check your work.

JOB SHEET 4

USE BASIC SURVEYING TECHNIQUES

X

OBJECTIVE 12d

Chain a horizontal distance as head chain person.

TOOLS, MATERIALS AND PERSONNEL

- Steel tape or chain
- Area indicated by the instructor
- Flag tape, chaining pin or other marker
- Rear chain person
- Compass
- Field notes and pencil or pen

PROCEDURE

1. Uncoil the steel tape to avoid kinks.

   NOTE: If the tape is straight, it will hold a pull of 100 pounds. If the tape is kinked or looped, a pull of 1 pound will usually break it.

2. Get the direction reading from the rear chain person and discuss any problems that might come up.
3. Take the foresight.
4. Walking backward or angled toward your partner, pull the "0" end of the chain in the direction indicated by the compass reading.

   CAUTION: Check the tape frequently to avoid kinks and tangles.

5. Stay in line according to the rear chain person's signals.
6. Stop when the rear chain person calls "chain."
7. Pull the chain taut (about 20 lbs of pressure) and level it.
8. Align as needed until the rear chain person calls "mark."
9. Place a flag, chaining pin or other marker under the "0" graduation.
10. Call to the rear chain person, "marked."
11. Take the backsight.

12. Compare the backsight and foresight readings, handle according to your instructor's decision.

13. Write in field notes the foresight, backsight, distance, and any other important factors such as weather, landmarks, soil conditions, etc.

14. Repeat the procedure until the area described by the instructor has been chained.

15. Have your instructor check your work.

16. Put away all tools and materials.

JOB SHEET 5

USE BASIC SURVEYING TECHNIQUES

X

OBJECTIVE 12e

Chain a horizontal distance as rear chain person.

TOOLS, MATERIALS AND PERSONNEL

- Steel tape or chain
- Area indicated by the instructor
- Compass directions for surveying
- Compass
- Head chain person
- Lubricating oil

PROCEDURE

1. Get the azimuth directions from the instructor.
2. Locate azimuth on the compass.
3. Give the direction reading to the head chain person and discuss any problems that might come up.
4. Watch as the head chain person pulls the "0" end of the chain in the direction indicated by the compass reading.
5. Compare the head chain person's movement with the compass reading and keep your partner on course by calling out directions.

   EXAMPLE: "Move left."
6. Call "chain" as the tape reaches the desired graduation mark.
7. Call out corrections or use hand signals to help the head chain person align the chain with the compass reading.
8. Call "mark" when the alignment is correct.
9. Wait in place until the head chain person calls "marked," and takes the backsight.
10. Handle differences in the foresight and backsight according to your instructor's decision.

11. Walk to the marker, pulling the tape.

    CAUTION: Be sure there are no kinks or loops in the tape.

12. Place the tape directly over the marker and repeat the procedure until the area described by the instructor has been chained.
13. Have your instructor check your work.
14. Clean AND oil tape.
15. Put away all tools and materials.

JOB SHEET 6

USE BASIC SURVEYING TECHNIQUES

X

OBJECTIVE 12f

Lay out a right–angle offset.

TOOLS, MATERIALS AND PERSONNEL

- Chain or tape
- Compass
- Field notes
- Pencil or pen
- Chaining partner
- Obstacle

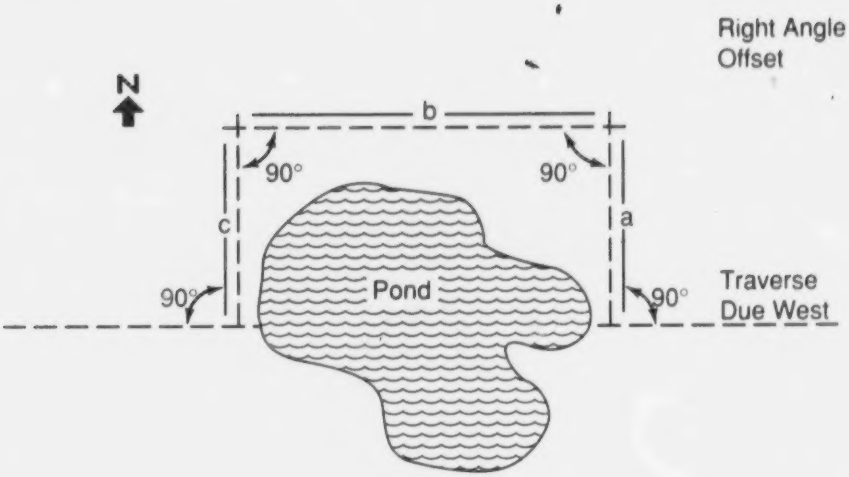
PROCEDURE

NOTE: The surveyor's path isn't always a clear one. Obstacles such as tree clumps, boulders, rivers, ponds, and other obstacles can make it impossible for the surveyor to site through and pace or chain an area. Offsetting is a technique that allows you to go around the obstacle in 90° angles and "offset" your course, to measure the same distance through a clear area.

In the example on the next page, the surveyor is traveling on a due–west line. The same procedure applies for any direction.

When you are not traveling due east, west, north or south, it's easy to make mistakes adding and subtracting the 90° turns, so be especially alert and careful.

Always take careful measurements, record them, and draw the offset in your field notes. Take backsights.



Distance a = c

Offsetting

1. Approach the obstacle, keeping on the survey line.
2. Stop before the obstacle, write in the notes your intention to offset and the direction.
3. Turn the compass housing 90° (to a right angle) to come to the offset angle.
4. Pace or chain until clear of the obstacle. (a)
5. Draw the offset angle and write down the distance in field notes.
6. Turn the compass housing 90° back to the original azimuth, in this case due west. (b)
7. Pace or chain due west until clear of the obstacle.
8. Draw the offset angle and write down the distance.
9. Turn the compass housing 90° (due north or south) toward the original line. (c)
10. Pace or chain the same distance covered in step 4.
11. Write down the distance and complete the drawing.

12. Turn due west, on the original line, and continue surveying.
13. Have your instructor check your work.
14. Put away tools and materials and clean the work area.

JOB SHEET 7

USE BASIC SURVEYING TECHNIQUES

OBJECTIVE 12g

Chain a slope.

TOOLS MATERIALS AND PERSONNEL

- Compass
- Abney topographic hand level
- 2–chain tape with trailer
- Flags or other markers
- Slope
- Chaining partner
- Field notes and pencil or pen

NOTE: The objective in surveying is to measure the horizontal distance. On a slope, the slope distance is greater than the horizontal distance and has to be measured as a horizontal distance. The difference can be obtained by using an Abney hand level and a trailer. The trailer is graduated into sections to correct the slope distance to the horizontal distance directly from the Abney reading. Remember the Abney reads *direct at one chain.*

PROCEDURE

NOTE: This procedure is for the rear chain person.

1. Determine eye level on head chain person's body.
2. Determine the direction to be measured.
3. Stand in place as the head chain person moves up or down the slope.
4. When the head chain person has covered a distance of 1 chain, call out "chain."
5. Stretch the tape.
6. Mark the zero point with a line in the dirt, a stick, flag or other marker.
7. Sight on partner with the Abney.

8. Read the *topographic scale* on the Abney.

9. Pick up the same marking on the trailer and move it to the zero point marker.

   NOTE: The trailer begins at the end of the 1–chain marker, and overlaps with the second chain.

10. Tell the head chain person to pull the chain, mark it and record it.

    NOTE: The slope distance is equal to a horizontal distance of 1 chain.

11. If using a 2–chain tape, proceed to the marked point; if using a 1–chain tape, repeat the procedure.

12. Let the head chain person pull two chains.

13. Stretch the tape.

14. Mark the zero point.

15. Read the Abney.

16. Double the reading.

    NOTE: The Abney reads direct at 1 chain. The measurement is now two chains = twice the distance.

    EXAMPLE: The Abney reads 8. 8 x 2 chains = 16

17. Pick up the doubled Abney reading on the trailer and move it to the zero point.

    NOTE: The trailer is at the end of the 2–chain marker.

    CAUTION: Beginning surveyors often make the mistake of doubling the trailer reading. *The rear trailer is already marked for two chains.*

18. Tell the head chain person to pull the chain.

19. When the chain is taut, tell the head chain person to mark it and record the distance.

    NOTE: That distance is the horizontal distance of a 2–chain slope.

20. Have your instructor check your work.

21. Put away tools and equipment.

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PRACTICAL TEST 1

USE BASIC SURVEYING TECHNIQUES

JOB SHEET 1

Adjust the compass to true readings.

Student's name ______________________________ Date ____________

Evaluator's name ____________________________ Attempt no. _____

Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

Evaluator note: Write a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.

The student:	YES	NO
1. Took an azimuth.	______	_____
2. Recorded it in field book or notes.	______	_____
3. Referred to the isogonic chart and found the declination for your area.	______	_____
4. Calculated the true reading.	______	_____
5. Recorded the true reading.	______	_____
6. Adjusted the compass:		
a. Set the magnetic needle at North.	______	_____
b. Located the declination adjusting screw.	______	_____
c. Picked up the screwdriver attached to the compass.	______	_____
d. Used the screwdriver to turn the screw in the direction of true north.	______	_____
e. Adjusted the screw until the needle pointed to the correct degree for the true reading.	______	_____
f. Replaced screwdriver.	______	_____
g. Rotated the compass dial to set the magnetic needle at North.	______	_____
7. Recorded the corrected reading.	______	_____
8. Used proper tools correctly.	______	_____
9. Performed steps in a timely manner.	______	_____
10. Practiced safety rules throughout procedure.	______	_____

The student:	YES	NO
11. Provided satisfactory responses to questions asked.	_____	_____
12. Put away tools and cleaned work area.	_____	_____

EVALUATOR'S COMMENTS

____

____

____

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See performance evaluation key). A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:	4	3	2	1
Adjusted the compass to true headings	accurate within ± 1°	accurate within ± 2°	accurate within ± 5°	in excess of 5°

EVALUATOR'S COMMENTS

____

____

____

AVERAGE RATING

Evaluator note: To obtain an average rating for the competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

PERFORMANCE EVALUATION KEY

4 – Skilled—Can perform job with no additional training

3 – Moderately skilled—Has performed job during training program, limited additional training may be required

2 – Limited skill—Has performed job during training program; additional training is required to develop skill

2 – Unskilled—Is familiar with process, but is unable to perform job

PRACTICAL TEST 2

USE BASIC SURVEYING TECHNIQUES

X

JOB SHEET 2

Determine the length of your pace.

Student's name ______________________ Date __________

Evaluator's name ______________________ Attempt no. _____

Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

Evaluator note: Write a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.

The student:	YES	NO
1. Measured and marked a straight, level course 100 feet long.	_____	_____
2. Placed the toe even and just to the side of marker #1.	_____	_____
3. Using a normal walking step, walked straight toward point #2.	_____	_____
4. Counted steps.	_____	_____
5. At point #2 wrote down the total number of steps, including any partial step at the end.	_____	_____
6. Recorded steps.	_____	_____
7. Turned back toward point #1: placed the toe even and just to the side of point #2 and repeat the above procedure.	_____	_____
8. Repeated steps 2–6, making a total of 4 passes.	_____	_____
9. Added the totals and divided the total footage by the total number of steps to determine the length of step.	_____	_____
10. Divided 66 by the length of step to determine the number of steps in a chain.	_____	_____
11. Used proper tools correctly.	_____	_____
12. Performed steps in a timely manner.	_____	_____
13. Practiced safety rules throughout procedure.	_____	_____
14. Provided satisfactory responses to questions asked.	_____	_____

The student: YES NO

15. Put away tools and cleaned work area. _____ _____

EVALUATOR'S COMMENTS

____

____

____

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See performance evaluation key). A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:				
	4 Accurately measured and marked course marked 100 ft	3 Measured and marked course within ± 1ft	2 Measured and marked within ± 2ft	1 Measured course with error over 2ft
	4 Paced with with a normal step	3 Step slightly too large or small	2 Step moderately too large or small	1 Step excessively large or small

EVALUATOR'S COMMENTS

____

____

____

AVERAGE RATING

Evaluator note: To obtain an average rating for the competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key."

PERFORMANCE EVALUATION KEY

4 – Skilled—Can perform job with no additional training
3 – Moderately skilled—Has performed job during training program, limited additional training may be required
2 – Limited skill—Has performed job during training program; additional training is required to develop skill
2 – Unskilled—Is familiar with process, but is unable to perform job

PRACTICAL TEST 3

USE BASIC SURVEYING TECHNIQUES

X

JOB SHEET 3

Pace unknown distances.

Student's name ______________________________ Date ____________

Evaluator's name ____________________________ Attempt no. _____

Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

Evaluator note: Write a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.

The student:	YES	NO
1. Paced and recorded distances:		
Area 1	_____	_____
Area 2	_____	_____
Area 3	_____	_____
2. Performed steps in a timely manner.	_____	_____
3. Practiced safety rules throughout procedure.	_____	_____
4. Provided satisfactory responses to questions asked.	_____	_____

EVALUATOR'S COMMENTS

____

____

____

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See performance evaluation key). A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:

	4 Paced accurately	3 Accurate within ± 1 ft	2 Accurate within ± 2 ft	1 In excess of 2 ft

EVALUATOR'S COMMENTS

AVERAGE RATING

Evaluator note: To obtain an average rating for the competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

PERFORMANCE EVALUATION KEY

4 – Skilled—Can perform job with no additional training
3 – Moderately skilled—Has performed job during training program, limited additional training may be required
2 – Limited skill—Has performed job during training program; additional training is required to develop skill
2 – Unskilled—Is familiar with process, but is unable to perform job

PRACTICAL TEST 4

USE BASIC SURVEYING TECHNIQUES

X

JOB SHEET 4

Chain a horizontal distance as head chain person.

Student's name ____________________________ Date ____________

Evaluator's name __________________________ Attempt no. _____

Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

Evaluator note: Write a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.

The student:	YES	NO
1. Uncoiled the steel tape to avoid kinks.	______	______
2. Got the direction reading from the rear chain person and discussed any problems that might come up.	______	______
3. Took the foresight.		
4. Pulled the "0" end of the chain in the direction indicated by the compass reading.	______	______
5. Stayed in line according to call of the rear chain person.	______	______
6. Stopped when the rear chain person called "chain."	______	______
7. Pulled the chain taut (20 lbs).	______	______
8. Aligned as needed until the rear chain person called "mark."	______	______
9. Placed a flag, chaining pin or other marker under the "0" graduation.	______	______
10. Called to the rear chain person, "marked."	______	______
11. Took the backsight.	______	______
12. Compared the backsight and foresight readings, handled according to instructor's decision.	______	______
13. Wrote in field notes the foresight, backsight, distance and any other important factors such as weather, landmarks, soil conditions, etc.	______	______

The student:	YES	NO
14. Repeated the procedure until the area described by the instructor had been chained.	______	______
15. Used proper tools correctly.	______	______
16. Performed steps in a timely manner.	______	______
17. Practiced safety rules throughout procedure.	______	______
18. Provided satisfactory responses to questions asked.	______	______
19. Put away tools and cleaned work area.	______	______

EVALUATOR'S COMMENTS

____

____

____

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See performance evaluation key). A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:	4	3	2	1
Chained a horizontal distance as head chain person	accurate within ± 2%	accurate within ± 3%	accurate within ± 4%	in excess of 5%

EVALUATOR'S COMMENTS

____

____

____

AVERAGE RATING

Evaluator note: To obtain an average rating for the competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key."

PERFORMANCE EVALUATION KEY

4 – Skilled—Can perform job with no additional training
3 – Moderately skilled—Has performed job during training program, limited additional training may be required
2 – Limited skill—Has performed job during training program; additional training is required to develop skill
2 – Unskilled—Is familiar with process, but is unable to perform job

PRACTICAL TEST 5

USE BASIC SURVEYING TECHNIQUES

X

JOB SHEET 5

Chain a horizontal distance as rear chain person.

Student's name ______________________ Date __________

Evaluator's name ____________________ Attempt no. _____

Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

Evaluator note: Write a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.

The student:	YES	NO
1. Got the azimuth from the instructor.	_____	_____
2. Located the azimuth on the compass.	_____	_____
3. Gave the azimuth reading to the head chain person and discussed any problems that might come up.	_____	_____
4. Watched as the head chain person pulled the "0" end of the chain in the direction indicated by the compass reading.	_____	_____
5. Called out corrections when the head chain person walked off course.	_____	_____
6. Called "chain" as the tape reached the desired graduation mark.	_____	_____
7. Called out corrections to help the head chain person align the chain with the compass reading.	_____	_____
8. Called "mark" when the alignment was correct.	_____	_____
9. Waited in place until the head chain person called "marked," and took the backsight.	_____	_____
10. Handled differences in the foresight and backsight according to instructor's decision.	_____	_____
11. Walked to the marker, pulling the tape.	_____	_____

The student:	YES	NO
12. Placed the tape directly over the marker and repeated the procedure until the area described by the instructor had been chained.	_____	_____
13. Cleaned tape, if needed.	_____	_____
14. Used proper tools correctly.	_____	_____
15. Performed steps in a timely manner.	_____	_____
16. Practiced safety rules throughout procedure.	_____	_____
17. Provided satisfactory responses to questions asked.	_____	_____
18. Put away tools and cleaned work area.		

EVALUATOR'S COMMENTS

____

____

____

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See performance evaluation key). A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:	4	3	2	1
Chained a horizontal distance as rear chainperson	accurate within 2%	accurate within 3%	accurate within 4%	in excess of 5%

EVALUATOR'S COMMENTS

____

____

____

AVERAGE RATING

Evaluator note: To obtain an average rating for the competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key."

PERFORMANCE EVALUATION KEY

4 – Skilled—Can perform job with no additional training
3 – Moderately skilled—Has performed job during training program, limited additional training may be required
2 – Limited skill—Has performed job during training program; additional training is required to develop skill
2 – Unskilled—Is familiar with process, but is unable to perform job

PRACTICAL TEST 6

USE BASIC SURVEYING TECHNIQUES

X

JOB SHEET 6

Lay out a right-angle offset.

Student's name ____________________________ Date ___________

Evaluator's name ___________________________ Attempt no. _____

Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

Evaluator note: Write a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.

The student:	YES	NO
1. Approached the obstacle, keeping on the survey line.	______	_____
2. Stopped before the obstacle, wrote in notes the intention to offset and the direction.	______	_____
3. Turned the compass housing 90° (to a right angle), to come to the offset angle.	______	_____
4. Paced or chained until clear of the obstacle.	______	_____
5. Drew the offset angle and wrote down the distance in field notes.	______	_____
6. Turned the compass housing 90° back to the original azimuth.	______	_____
7. Paced or chained until clear of the obstacle.	______	_____
8. Drew the offset angle and wrote down the distance.	______	_____
9. Turned the compass housing 90° toward the original line.	______	_____
10. Paced or chained the same distance covered in step 4.	______	_____
11. Wrote down the distance and completed the drawing.	______	_____
12. Turned on the original line, and continued surveying.	______	_____

The student:	YES	NO
13. Used proper tools correctly.		
14. Performed steps in a timely manner.		
15. Practiced safety rules throughout procedure.		
16. Provided satisfactory responses to questions asked.		
17. Put away tools and cleaned work area.		

EVALUATOR'S COMMENTS

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See performance evaluation key). A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:	4	3	2	1
Laid out a right-angle offset	accurate	accurate within ± 1 ft	accurate within ± 2 ft	in excess of 2 ft

EVALUATOR'S COMMENTS

AVERAGE RATING

Evaluator note: To obtain an average rating for the competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key."

PERFORMANCE EVALUATION KEY

4 – Skilled—Can perform job with no additional training
3 – Moderately skilled—Has performed job during training program, limited additional training may be required
2 – Limited skill—Has performed job during training program; additional training is required to develop skill
2 – Unskilled—Is familiar with process, but is unable to perform job

PRACTICAL TEST 7

USE BASIC SURVEYING TECHNIQUES

X

JOB SHEET 7

Chain a slope.

Student's name ______________________ Date __________

Evaluator's name ______________________ Attempt no. _____

Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

Evaluator note: Write a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.

The student:	YES	NO
1. Determined eye level on head chain person's body.	_____	_____
2. Determined the direction to be measured.	_____	_____
3. Stood in place as the head chain person moved up or down the slope.	_____	_____
4. When the head chain person had covered a distance of 1 chain, called out "chain."	_____	_____
5. Stretched the tape.	_____	_____
6. Marked the zero point with a line in the dirt, a stick, flag or other marker.	_____	_____
7. Sighted on partner with the Abney.	_____	_____
8. Read the *topographic scale* on the Abney.	_____	_____
9. Picked up the same marking on the trailer and moved it to the zero point marker.	_____	_____
10. Told the head chain person to pull the chain, mark it and record it.	_____	_____
11. If using a 2–chain tape, proceeded to the marked point; if using a 1–chain tape, repeated the procedure.	_____	_____
12. Let the head chain person pull two chains.	_____	_____
13. Stretched the tape.	_____	_____
14. Marked the zero point.	_____	_____
15. Read the Abney.	_____	_____
16. Doubled the reading.	_____	_____

The student:	YES	NO
17. Picked up the doubled–Abney reading on the trailer and moved it to the zero point.	____	____
18. Told the head chain person to pull the chain.	____	____
19. When the chain was taut, told the head chain person to mark it and record the distance.	____	____
20. Used proper tools correctly.	____	____
21. Performed steps in a timely manner.	____	____
22. Practiced safety rules throughout procedure.	____	____
23. Provided satisfactory responses to questions asked.	____	____
24. Put away tools and cleaned work area.		

EVALUATOR'S COMMENTS

____

____

____

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See performance evaluation key). A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:	4	3	2	1
Chained a slope	accurate	accurate within ± 1 ft	accurate within ± 2 ft	in excess of 2 ft

EVALUATOR'S COMMENTS

____

____

____

AVERAGE RATING

Evaluator note: To obtain an average rating for the competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

PERFORMANCE EVALUATION KEY

4 – Skilled—Can perform job with no additional training
3 – Moderately skilled—Has performed job during training program, limited additional training may be required
2 – Limited skill—Has performed job during training program; additional training is required to develop skill
2 – Unskilled—Is familiar with process, but is unable to perform job

WRITTEN TEST

USE BASIC SURVEYING TECHNIQUES X

NAME ________________________________ SCORE _______

OBJECTIVE 1

Match terms associated with surveying to their correct definitions. Write the correct letters in the blanks.

____ 1. Divided into measuring parts

____ 2. A measurement of horizontal distance

____ 3. The actual axis around which the earth spins

____ 4. The measuring of an open or closed horizontal distance by a surveyor or survey team

____ 5. Using a part of the chain for a measurement

____ 6. The degree to which magnetic north varies from true north

____ 7. The difference in direction where two horizontal lines meet

____ 8. A geological direction caused by the earth's magnetism

____ 9. A line along which two areas meet

___ 10. Compass reading made in a forward direction

___ 11. A straight line measured over the ground

___ 12. Compass reading made 180° from the foresight

___ 13. The physical features of a tract of land

___ 14. The science of measuring the earth's surface: distances, directions, and elevations; computing areas and volumes; and preparing maps of the measured area

___ 15. Based on random or convenient choice

a. Arbitrary

b. Backsight

c. Boundary line

d. Breaking the chain

e. Chain

f. Declination

g. Demarcation line

h. Foresight

i. Graduated

j. Horizontal angle

k. Horizontal distance

l. Horizontal differential

m. Surveying

n. Laying the chain

o. Magnetic north

p. Marker

q. Open angle

r. Property line

s. Reverse sight

t. Terrain

u. Traverse

v. True North

___16. A way to estimate the volume and value of timber on a tract

___17. The portion of a surveying tape used to measure slope

___18. An imaginary line running north and south through any given point on the earth's surface

w. Cruise

x. Geologic North

y. Meridian

z. Lateral distance

aa. Trailer

OBJECTIVE 2

Choose words or phrases to complete statements about why surveying is important in forestry. Circle the correct answer or answers.

1. The information from the survey is used to ___________.
    a. create a land description
    b. set land values
    c. draw a map
    d. select timber for harvesting
2. Markers are used to ____________.
    a. identify boundaries
    b. indicate which team is to cruise the area
    c. select trees for cutting
    d. estimate tree volume
3. How accurate a survey has to be depends on the ___________.
    a. qualifications of the survey team and how much they're paid
    b. size of the area to be surveyed and the value of the timber
    c. value of the whole property and the size of the area to be surveyed
    d. value of the timber and the difficulty of the terrain

4. Surveying does NOT ___________.

   a. measure how many acres of land are in a stand or on the property
   b. show ownership boundaries
   c. locate specific sites or landmarks
   d. give an estimate of timber stand value
   e. show timber stand boundaries

OBJECTIVE 3

Select from a list characteristics of a forest survey. Write an "X" in the blank before each correct answer.

____ 1. If a team is looking for a certain point, a certain location or marker, they make an open traverse.

____ 2. Both members of the survey team carry compasses.

____ 3. There are two members of the survey team, the head chain person and the rear chain person.

____ 4. There are two methods of measuring a horizontal distance, pacing and chaining, also called taping.

____ 5. If they are measuring a timber stand, they make a closed traverse, returning to the starting point.

____ 6. Corners and angles are measured with an Abney hand level.

____ 7. Forest surveying is different from other types of surveying.

____ 8. Where construction surveyors use 100 feet, 200 feet or 300 feet measurements, many foresters use a 120 foot measure.

____ 9. Chaining is not an accurate measure, but it is more accurate than pacing.

____ 10. Surveyors use different techniques in brush and in wooded areas than on cleared land or along fencelines.

____ 11. One member of the team carries field notes to record measurements, the other usually carries the markers.

____ 12. Vertical angles such as slopes are measured with an Abney hand level.

____ 13. Forest surveying is performed by a three–person team, the head chain person, the rear chain person, and the supervisor.

____ 14. Pacing is not an accurate measure, but is used for rough estimates.

OBJECTIVE 4

Match surveying tools to their descriptions. Write the correct letters in the blanks.

____1. Chains are 100 feet long with links of 1 foot each; available in 100, 200 and 300 foot lengths; can be metal, plastic or fiberglass

____2. 1– or 2–chain plastic–coated measure with color–coded links, chains and trailer; chains are 66 feet

____3. Used with the slope tape; measures the angle between the horizontal plane and the line of sight along a slope

____4. Used to measure the magnetic bearing of a line or to run a reasonably straight line through the woods

____5. A surveyor's tape with a trailer

____6. 1– or 2–chain measure graduated in links may have a trailer; usually comes on a reel

____7. Brightly colored tape, usually dayglow orange, tied onto branches or wooden stakes as markers

____8. Used to mark out chain lengths or shorter lengths while measuring a shorter distance

a. Abney hand level

b. Chaining pins

c. Compass

d. Engineer's tape

e. Expandable tape

f. Flags

g. Forester's tape

h. Markers

i. Pacing tape

j. Right angle

k. Rope chain

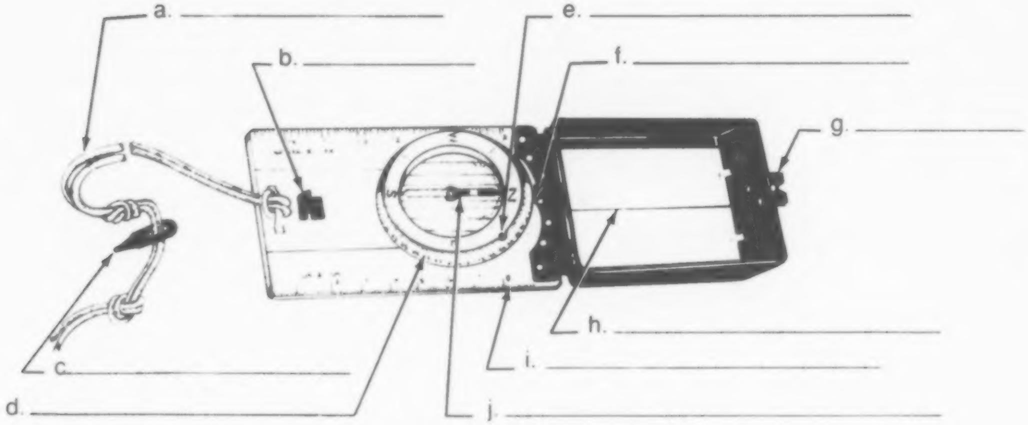
l. Slope chain

m. Stakes

n. Steel tape

o. 3–color chain

OBJECTIVE 5 **Label parts of a compass.** Write the correct words in the blanks.



OBJECTIVE 6 **Match compass measurements to their values and symbols.** Write the correct letters in the blanks.

____ 1.
____ 2. °
____ 3. ″
____ 4. Full circle
____ 5. 1 degree
____ 6. Degrees, minutes, and seconds of arc
____ 7. 1 minute

a. 360°
b. 180°
c. 90°
d. minute symbol
e. degree symbol
f. full circle symbol
g. measurements for angles
h. 180 seconds
i. 60 minutes
j. 60 seconds
k. 30 minutes
l. second symbol

OBJECTIVE 7

Distinguish between azimuths and bearings. Write "A" in the blanks before statements describing azimuths and "B" in the blanks before statements describing bearings. If a statement is true of both, write "AB" in the blank.

____ 1. N42°35'E

____ 2. The reference meridian is usually north

____ 3. A horizontal angle measured in 90° quadrants on the compass

____ 4. 273°15'22"

____ 5. A horizontal angle measured clockwise from 0° to 360° on a compass

____ 6. The range is from 0° to 90° and can never be greater than 90°

____ 7. Requires only a numerical value

____ 8. To determine which side of the meridian the reading goes, an east or west is added

____ 9. Is measured in degrees, minutes, and seconds of arc

___ 10. Is measured from the north or south end of a meridian

___ 11. Is measured either clockwise or counterclockwise

OBJECTIVE 8

Choose the best word or phrase to complete statements about pacing. Circle the correct answers.

1. Generally, a pace is considered to be ___________.

   a. 36 inches or 3 feet

   b. every other step

   c. two natural steps

   d. 24 inches or 2 feet

2. Pacing is used to measure ___________.
   - a. flat terrain, any distance
   - b. short and long distances
   - c. short distances
   - d. long distances

3. Pacing is useful for all of these EXCEPT:___________.
   - a. marking exact measurements
   - b. detecting blunders
   - c. looking for survey markers
   - d. checking measurements

4. You measure your pace on the same type of terrain to be surveyed because ___________.
   - a. practicing your pace will help prevent possible accidents
   - b. checking your pace on uneven terrain ahead of time saves time during the actual surveying
   - c. pacing downhill or uphill alters your step
   - d. rough country is paced differently

OBJECTIVE 9

Convert chaining measurements. Write the correct information in the blanks.

1. A chain =
   - a. ______feet
   - b. about ______ meters
2. 1 chain has ______ links
3. 1 link =
   - a. ______ inches
   - b. ______ feet
   - c. ______ centimeters
4. ______ chains = 1 mile
5. ______ chains = 1 kilometer

6. ______ chains = 1 acre

7. 1 Pole or rod =

a. ______ of a chain

b. ______ feet

c. ______ meters

OBJECTIVE 10

Distinguish between survey team members' tasks. Write "R" in the blank before rear chain person's tasks, or "H" in the blank before head chain person's tasks.

____ 1. Maintains care and storage of equipment

____ 2. Keeps count of all full tape lengths and records them

____ 3. Places all chaining marks or pins, calling out "chained" or "marked"

____ 4. Calls out "chain" or "mark" when in position

____ 5. Prepares the ground surface for the mark

____ 6. Applies proper tension, checking that the tape is horizontal

____ 7. Records measurements

____ 8. Holds the tape precisely over the rear mark

____ 9. Keeps the head chain person aligned toward the station with a compass

___ 10. Carries the tape or chain forward along the compass line, being careful there are no loops

___ 11. Supervises the survey work in progress

NOTICE

The following assignment sheets and job sheets are not part of the written test. If these activities have not been completed, check with your instructor.

OBJECTIVE 11

Use an isogonic chart to correct magnetic readings to true readings. SCORE ________

OBJECTIVE 12

Demonstrate the ability to

a. Adjust the compass to true readings. RATING ______

b. Determine the length of your pace. RATING ______

c. Pace unknown distances. RATING ______

d. Chain a horizontal distance as the head chain person. RATING ______

e. Chain a horizontal distance as the rear chain person. RATING ______

f. Lay out a right-angle offset. RATING ______

g. Chain a slope. RATING ______

OBJECTIVE 1

1. k
2. e
3. v
4. u
5. d
6. f
7. j
8. o
9. c
10. h
11. k
12. b
13. t
14. m
15. a
16. w
17. aa
18. y

OBJECTIVE 2

1. a, c
2. a
3. b
4. d

OBJECTIVE 3

1, 2, 3, 4, 5, 7, 10, 11, 12, 14

OBJECTIVE 4

1. d
2. k
3. a
4. c
5. l
6. n
7. f
8. b

OBJECTIVE 5

a. Safety cord
b. Sight
c. Screwdriver
d. Compass dial
e. Declination adjusting screw
f. Index pointer
g. Sight
h. Sighting line
i. Map scale
j. Magnetic needle

OBJECTIVE 6

1. d
2. e
3. l
4. a
5. i
6. g
7. j

OBJECTIVE 7

1. B
2. A
3. B
4. A
5. A
6. B
7. A
8. B
9. A, B
10. B
11. B

OBJECTIVE 8

1. c
2. c
3. a
4. c

OBJECTIVE 9

1. a. 66
   b. 20
2. 100
3. a. 7.92
   b. .66
   c. 20.1
4. 80
5. 47.9
6. 10 square
7. a. 1/4
   b. 16.5
   c. 5

OBJECTIVE 10

1. R
2. R
3. H
4. R
5. H
6. H
7. H
8. R
9. R
10. H
11. H

OBJECTIVE 11

Refer to answers to Assignment Sheet 1.

OBJECTIVE 12

Refer to Practical Test Ratings for Job Sheets 1 through 7.

OBJECTIVE SHEET

USE LEGAL LAND DESCRIPTIONS

XI

INTRODUCTION

If you choose forestry or any agricultural career, knowing how to describe and locate legal land descriptions will be a major part of your communication about land. You may already know a little about sections, quarters, and half-sections. In this unit, you'll learn why we use this system and how the land is divided throughout the United States.

UNIT OBJECTIVE

After completing this unit, the student should be able to use legal land descriptions to locate and describe land tracts for forestry or other uses. The student will demonstrate these competencies by completing the assignment sheets and written test with a minimum of 85 percent accuracy.

PREREQUISITES

Unit VIII: *Use Basic Math for Forestry*
Unit X: *Use Basic Surveying Techniques*

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with legal land descriptions to their correct definitions.
2. List reasons for land location in forestry.
3. Distinguish among types of legal land descriptions.
4. Match line divisions used in the United States Public Land, Survey (USPLS) system to their descriptions.
5. Choose the correct word or phrase to complete statements about subdivisions of the USPLS.
6. Choose the correct word or phrase to complete statements about reading USPLS system subdivision descriptions.
7. Identify the principal meridians, base lines, and initial points in your state.
8. Select from a list information found on a map legend.
9. Label contour configurations.
10. Identify subdivisions of the USPLS system. (Assignment Sheet 1)
11. Interpret descriptions for the subdivision of a section. (Assignment Sheet 2)

12. Determine distance and direction on a topographic map. (Assignment Sheet 3)

13. Identify symbols and features on a United States Geological Survey (USGS) map. (Assignment Sheet 4)

USE LEGAL LAND DESCRIPTIONS

PREPARATION

- Obtain materials to supplement unit.

  NOTE: See Suggested Resources.

- Review instructional outline for this unit. Modify time frames to suit class needs and plan activities for each period.
- Study the specific objectives to determine those you will cover in your presentation. Decide which objectives should be taught to which students.
- Determine scope and sequence of objectives that you add. Design and develop support materials, including evaluation techniques, for additional objectives.
- Determine how you will schedule time for students to demonstrate competence in the required procedures.
- Invite a surveyor to talk with the class about land location.
- Invite a forester to talk about the importance of land location in forestry.

  NOTE: Supply speakers with specific objectives and other appropriate sections of the unit.

- Learn the types of legal land descriptions used in your county and obtain the legal land description of the school.
- Arrange a field trip to the county courthouse to look up deeds and land descriptions.
- Locate markers or monuments near the school for students to see.

DELIVERY

Objectives 1 and 2

- Review terms and definitions.
- Share with the class your own experiences in land location.

- Use practical examples of the useful skills learned in this unit and tie it to the students' interests and experience.

  EXAMPLE: Many large-area landowners have surveyors or technicians walk all the external boundaries frequently to prevent someone else's use.

- Have a forester discuss the importance of land location in forestry.

Objective 3

- Show students the types of land descriptions used in your area.
- Take students on a field trip to the courthouse to look up deeds.
- Assign students to obtain the legal land descriptions of their homes either from their own property deeds or from the courthouse.

Objectives 4 through 7

- Have students identify the guide meridians and standard parallels nearest to your area.
- Have students locate their quadrangle, township, and range.
- Use a transparency of Supplement 4 to show the relationships among land divisions and descriptions.
- Have students complete Assignment Sheet 1.
- Have students complete Activity Sheet 1.
- Have students complete Assignment Sheet 2.
- Have a contest between teams to mark areas on a map or to describe land locations.
- Encourage students to use their survey skills and skills in reading land descriptions to complete Activity Sheet 2.

Objectives 8 through 10

- Show students examples of topographic maps, road maps and specialized maps. Have them locate and identify symbols.
- Have students complete Assignment Sheet 3.
- Have students complete Activity Sheet 3.
- Have students complete Assignment Sheet 4.

APPLICATION

Objective 10

- Use Assignment Sheet 1 to give students the opportunity to learn the divisions of the USPLS system.

Objective 11

- Use Assignment Sheet 2 to help students learn to interpret descriptions for the subdivision of a section.

Objective 12

- Use Assignment Sheet 3 to teach students how to determine distance and direction on a topographic map.

Objective 13

- Use Assignment Sheet 4 to give students direct experience in identifying symbols and features on a USGS map.
- Obtain USGS 7.5 Minute Quadrangle map for Stillwater North or a map of your area and adapt Assignment Sheet 4. See Suggested Resources.

EVALUATION

Written test

- Explain to students that they will be asked to demonstrate on the written test actions listed in the specific objectives.
- Give written test.

  NOTE: The written test may be given in sections if desired.

- Evaluate students on assignment sheet activities if not previously done.
- Reteach and retest if necessary.

- Complete appropriate section of competency profiles.
- Review individual and group performance in order to evaluate teaching methods. Adjust scope, sequence, or instructional approaches for additional lessons as required.

SUGGESTED RESOURCES

Publications and Other Media

- Topographic maps for your area.
- Transparencies of topographic maps of your area.
- Index to topographic and other map coverage for your state. Published by the U.S. Geological Survey National Mapping Program. Available from The U.S. Geological Survey, Box 25286, Federal Center, Bldg. 41, Denver, Colorado 80225 or by calling (303) 236-7477.

  NOTE: A topographic map of the Stillwater North Quadrangle 7.5 minutes series is available from the Curriculum and Instructional Materials Center, Oklahoma Department of Vocational and Technical Education, 1500 W. Seventh Avenue, Stillwater, Oklahoma 74074-4364. Oklahoma teachers may call (800) 522-5810 ext. 589. Out of state teachers may call (800) 654-4502.

- Transparency of Supplement 4.
- State road maps and other special-purpose maps.

UNIT REFERENCES

- Curtis, Ed, *Forestry*, Curriculum and Instructional Materials Center, Oklahoma Department of Vocational and Technical Education, Stillwater, Oklahoma, 1974.
- Olson, David A., *Basic Surveying Technology*, Mid-America Vocational Curriculum Consortium, Inc., Stillwater, Oklahoma, 1987.
- Shertz, Karen, *Civil Drafting*, Mid-America Vocational Curriculum Consortium, Inc., Stillwater, Oklahoma, 1986.

DEALERS FOR TOPOGRAPHIC MAPS

Many of the maps described in this book are stocked and sold over the counter by the Oklahoma dealers listed below. Prices may vary from those charged by the USGS.

Map Selections may vary with each dealer: (A) local coverage only (B) county coverage (C) area (regional) coverage (D) state coverage (E) multi-state coverage (F) special maps.

ATOKA:
Southeastern Engineering Corp.
119 North Ohio Street
(405) 889-6664
(C)

BARTLESVILLE:
Ben's Mapping & Engineering
415 East Fifth Street
(918) 336-3816
(C)

Examiner-Enterprise
300 East Frank Phillips Boulevard
(918) 336-1600
(E)

HEAVENER:
The Heavener Ledger
507 East First Street
(918) 653-2425
(C)

MIAMI:
Miami News-Record
14 First Avenue, NW
(918) 542-5533
(C)

NORMAN:
Oklahoma Geological Survey
830 Van Vleet Oval, Rm. 163
(405) 325-3031
(E) (F)

OKLAHOMA CITY:
Backwoods Equipment Company
12325 North May Avenue, Suite 103
(405) 751-7376
(E)

Petroleum Information Co.
4334 Northwest Expressway Street,
Suite 100
(405) 848-9824
(C)

Topographic Engineering Co.
6709 North Classen Boulevard
(405) 843-4847
(E) (F)

Wilderness Adventurer, Inc.
5619 North Pennsylvania Avenue
(405) 842-5447
(E) (F)

PAWHUSKA:
Osage Surveying Service
100 West Main Steet
(918) 287-4029
(E)

PONCA CITY:
Blubaugh Engineering Co.
705 Hubbard Road
(405) 762-6608
(C)

STILLWATER:
R & J Systems, Inc.
611 West Highpoint Drive
(405) 624-0404
(B)

TULSA:
D & B Outfitters
4606 East 11th Street
(918) 834-8622
(E) (F)

Maps, Plaques & Laminating
3315 South Harvard Avenue
(918) 744-4494
(E) (F)

Petroleum Information Co.
5310 East 31st Street
(918) 664-4293
(E) (F)

Ridgways
7226 East 41st Street
(918) 663-8100
(D) (F)

MAP DEPOSITORY LIBRARIES

Libraries at the following locations in Oklahoma have been designated as depositories for many of the published maps of the U.S. Geological Survey. Library personnel are specialists in advising patrons on coverage and availability of maps and cartographic products. Users may wish to preview maps prior to ordering.

ADA:
East Central University, Linscheid Library

ALVA:
Northwestern State University, Martin Library

DURANT:
Southeastern State University, Bennett Library

EDMOND:
Central State University Library

ENID:
Public Library of Enid and Garfield County, 120 West Maine Avenue

LAWTON:
Museum of the Great Plains, 601 Ferris Avenue

NORMAN:
University of Oklahoma, Geology Library
University of Oklahoma, Law Library

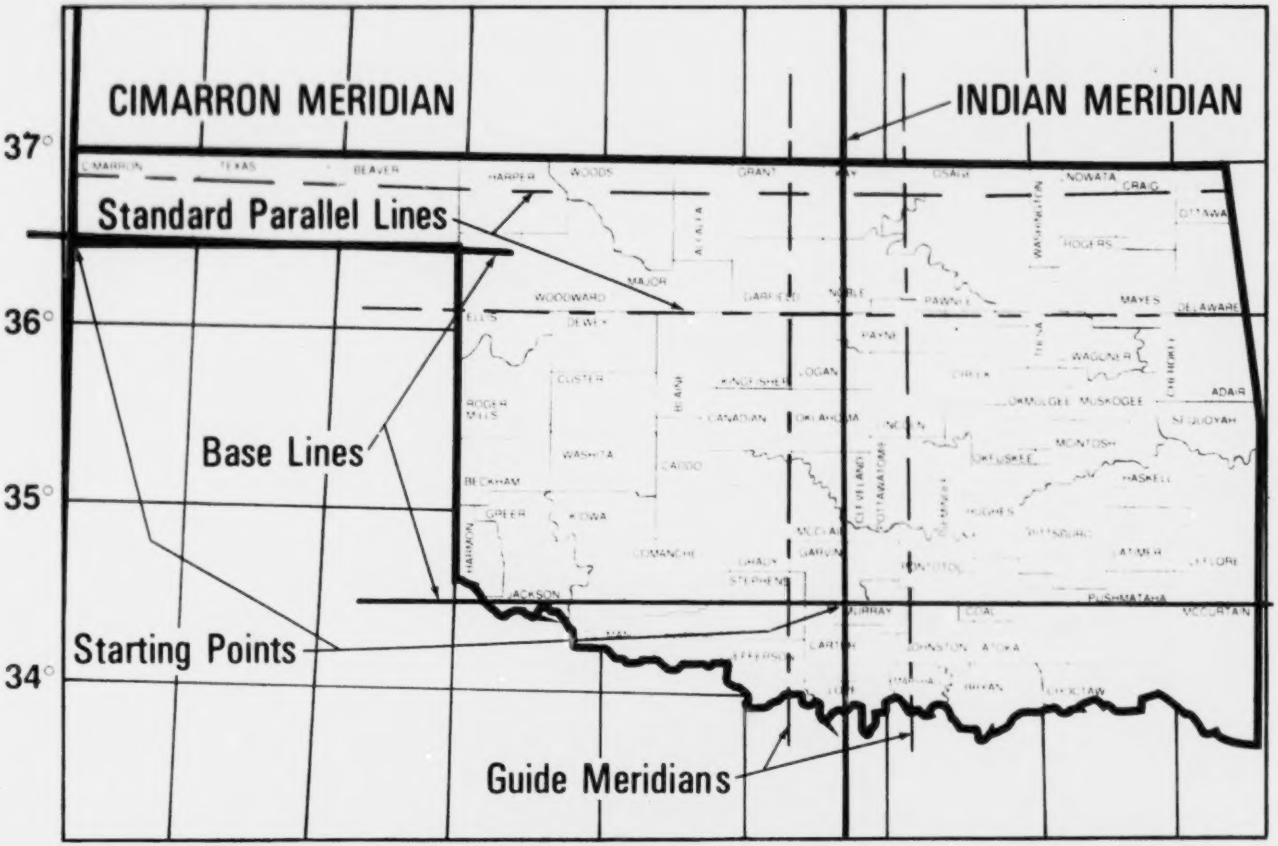
OKLAHOMA CITY:
Metropolitan Library Systems, 334 Southwest 26th Street
Oklahoma City University, Browne Library
Oklahoma Department of Libraries, 200 Northeast 18th Street

STILLWATER:
Oklahoma State University,
Edmond Low Library

TAHLEQUAH:
Northeastern State University,
Vaughn Library

TULSA:
Tulsa City–County Library,
400 Civic Center,
University of Tulsa,
McFarlin Library

Principal Meridians And Base Lines


CIMARRON MERIDIAN
INDIAN MERIDIAN
37°
36°
35°
34°
Standard Parallel Lines
Base Lines
Starting Points
Guide Meridians
CIMARRON
TEXAS
BEAVER
HARPER
WOODS
GRANT
KAY
OSAGE
NOWATA
CRAIG
OTTAWA
WASHINGTON
ROGERS
ALFALFA
MAJOR
WOODWARD
GARFIELD
NOBLE
PAWNEE
MAYES
DELAWARE
ELLIS
DEWEY
PAYNE
TULSA
WAGONER
CHEROKEE
CUSTER
BLAINE
KINGFISHER
LOGAN
CREEK
ADAIR
ROGER MILLS
CANADIAN
OKLAHOMA
LINCOLN
OKMULGEE
MUSKOGEE
SEQUOYAH
WASHITA
CADDO
MCINTOSH
OKFUSKEE
BECKHAM
CLEVELAND
POTTAWATOMIE
SEMINOLE
HASKELL
GREER
KIOWA
MCCLAIN
HUGHES
PITTSBURG
HARMON
COMANCHE
GRADY
GARVIN
LATIMER
LEFLORE
STEPHENS
PONTOTOC
JACKSON
PUSHMATAHA
MURRAY
COAL
MCCURTAIN
CARTER
JOHNSTON
ATOKA
JEFFERSON
MARSHALL
BRYAN
CHOCTAW

Location of the two principal meridians (—) and base lines (—) in Oklahoma. Two guide meridians (—-—) and two standard parallel lines (---) are also shown.

- **Panhandle base line at latitude North 36°30′05"**—Runs along the southern border of the panhandle only (Locate this base line on Supplement 1).

- **Cimarron Meridian (CM)**—Intersects with the base line in Cimarron County; initial point for the panhandle is at longitude West 103°00′07".

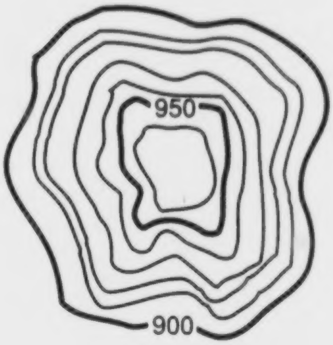
- **Main base line at latitude North 34°29′32"**—Runs through southern Oklahoma from Arkansas to the Texas panhandle border

- **Indian Meridian (IM)**—Intersects with the base line in Murray County; initial point for the main body of Oklahoma at longitude West 97°14′49".

OBJECTIVE 1

Match terms associated with legal land descriptions to their correct definitions.

- **Bearing**—Horizontal angle measured from north or south and referenced to one of the quadrants of the compass
- **Blaze**—A vertical scribe made with an ax or with paint
- **Contour line**—An imaginary line on the ground connecting all points that are the same elevation above or below sea level



Contour Lines

- **Contour interval**—The vertical distance between the planes of consecutive contour lines, such as 5, 10, 20, 100, or 200 feet or meters

  NOTE: What is the interval in the picture of contour lines above?

- **Elevation**—Vertical distance above or below sea level
- **Fractional**—Partial
- **Hack**—A horizontal notch made on the side of a tree or rock; or a horizontal line painted on a tree or rock
- **Index contour line**—Every 5th contour line, which indicates the elevation

- **Legal land description**—A written statement recognized by law as the definite location of a tract of land by reference to a survey, recorded map, adjoining property, or recorded monument

- **Legend**—Section of a map that explains the symbols used on that map

  NOTE: The legend is sometimes called a "key."

- **Monument**—Permanent object, natural or artificial, that marks established points

  NOTE: "Monumented" means marked with a monument.

  EXAMPLES: **Natural:** Rivers, natural landmarks, or trees marked as monuments

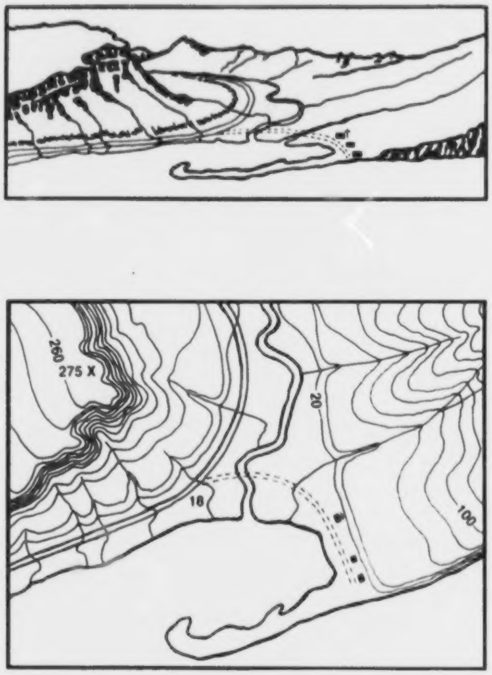
  Artificial: Wooden stake, stone, or other permanent marker properly located and witnessed

- **Plat**—A map of a piece of land

- **Sea level**—The average elevation between high and low tide

- **Topographic map**—A line and symbol representation of natural and selected man-made features of a part of the earth's surface plotted to a definite scale; portrays the shape and elevation of the terrain by contour lines

  NOTE: Topographic maps are produced by the United States Geological Survery and are made with data gathered from aerial photos, remote sensing, electronic and manual surveying. USGS maps are a major tool in forestry, used for orientation, site location, surveying, working with drainage patterns, and other activities that involve extensive outdoor work in large areas.



Terrain As Portrayed On A Topographic Map

Used with permission of the Boy Scouts of America.

- **USGS**—United States Geological Survey
- **USPLS**—United States Public Land Survey
- **Vara (VER-uh)**—A unit of measurement approximately equal to a man's step

OBJECTIVE 2

List reasons for land location in forestry.

- **Retrace old boundary lines**—Boundaries have to be clearly marked so loggers can see them easily and cut only on the property they are harvesting. Most large landowners have forest surveyors or technicians walk the boundaries regularly to prevent other people from building on or using their land.

- **Locate property boundaries**—When property is leased, bought or sold, the boundaries are checked to be sure that the claim is as it should be.

- **Lay out boundaries for specific uses**—Land to be used for timber sales, recreation sites, construction, etc. must be accurately located and marked before use.

OBJECTIVE 3

Distinguish among types of legal land descriptions.
(Supplements 1, 2, and 3)

NOTE: A complete description of property may include all three types of descriptions in combination. Texas uses a separate system of description called the Spanish or Vara system.

- **U.S. public land survey system (USPLS)**—A system put in place by the Continental Congress on May 20, 1785 for the survey of all public lands in the United States. The purpose is to survey land so that in general, and in all cases where practical, the survey units are rectangles. The USPLS is also called "the sectional system" and the "rectangular system." (See Supplement 1)

  EXAMPLE: N1/2 NW1/4 SW1/4, Section 6, T55N, R69W

- **Lot and block description**—A system of describing land by referring to a recorded plat, the lot number, the county, and state. (See Supplement 2)

  EXAMPLE: Lot 2 of Paradise Valley, being a subdivision of a part of the Southwest Quarter of Section 29, Township 18 North, Range 1 East of the Indian Meridian, in accordance with that certain plat recorded in Volume 195, at Page 245, of the Miscellaneous Deed Records of Payne County, Oklahoma.

- **Metes and bounds**—A system of describing land from a starting point on the boundary, listing the compass directions and distances from point to point entirely around the tract. It is used to describe irregularly shaped tracts. The description of a forest tract is a simplified metes and bounds description.

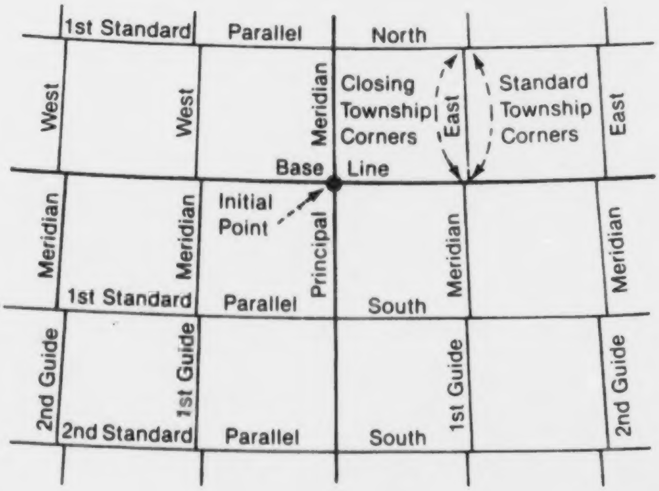
NOTE: Metes and bounds is the oldest known method of describing land. It was used, and is still used, in the original 13 states. A plat is drawn from a metes and bounds description. Areas are always closed traverses.

OBJECTIVE 4

Match line divisions used in the United States Public Land Survey (USPLS) system to their descriptions. (Supplement 4)

- **Base line**—The latitude, a principal parallel line running true east and west; it intersects the principal meridians at the initial point
- **Principal meridian**—The longitude, a line running true north and south, that intersects the base line at the initial point
- **Standard parallels**—Lines surveyed every 24 miles north and south of the base line and parallel with it
- **Guide meridians**—True meridians extended north from the base line or from standard parallels at intervals of 24 miles east and west from the principal meridian

NOTE: Standard parallels and guide meridians compensate for the curvature of the earth. Notice how the north and south parallels (also called "correction lines") are slightly curved; and the meridians are not precisely aligned.


1st Standard
Parallel
North
West
West
Meridian
Closing
Township
Corners
East
Standard
Township
Corners
East
Base
Line
Initial
Point
Principal
Meridian
Meridian
Meridian
Meridian
1st Standard
Parallel
South
2nd Guide
1st Guide
1st Guide
2nd Guide
2nd Standard
Parallel
South

Guide Meridians

- **Initial point**—Formed by the intersection of the base line and the principal meridian
- **Township lines**—East-west lines at six-mile intervals parallel to the base line

  NOTE: Correction lines are located every six miles on the standard parallel.
- **Range lines**—North-south lines at six-mile intervals parallel to the principal meridian

OBJECTIVE 5

Choose the correct word or phrase to complete statements about subdivisions of the USPLS system.
(Supplements 4 and 5)

Using astronomical observation, the USPLS has established 37 initial points that serve as the starting points for subdividing public lands. The principal meridians and base lines pass through initial points and make up the framework for the system. There are 35 principal meridians and 32 base lines. The meridians are marked, monumented, and fixed by a longitudinal reading (so many degrees, minutes, and seconds west of the Greenwich Meridian). Some principal meridians are numbered, some are named, such as the Indian Meridian, The Black Hills Meridian, and the 5th Principle Meridian. The base lines are fixed astronomically (so many degrees north of the equator). (Refer to Supplement 1)

- **Quadrangles**—Approximately 24-square mile divisions bounded by the base lines, principal meridians, standard parallel and guide meridians. Quadrangles are divided into townships.
- **Townships (T)**—Division of territory six miles long on its south, east, and west boundaries and slightly less than six miles on the north. Townships are numbered consecutively North or South from an initial point to a designated border as shown in the shaded areas of Supplement 1.

  Townships are divided into 36 sections. Markers such as plates, monuments or blazes and hacks are placed at all corners. (Refer to Supplement 5)

- **Ranges (R)**—Row or line of north-south townships, six miles apart and numbered consecutively east or west from an initial point to a designated area as shown on the shaded areas of Supplement 1.

  Both the township number and the range number are needed to locate a township.

  EXAMPLE: T2S, R4E; T41N, R67

- **Sections**—Approximately 1 square mile (640 acres). The sections in each township are numbered from 1 to 36 beginning with #1 in the northeast corner and #36 in the southeast corner. Section and quarter-section corners are marked by surveyors. (Refer to Supplement 5)

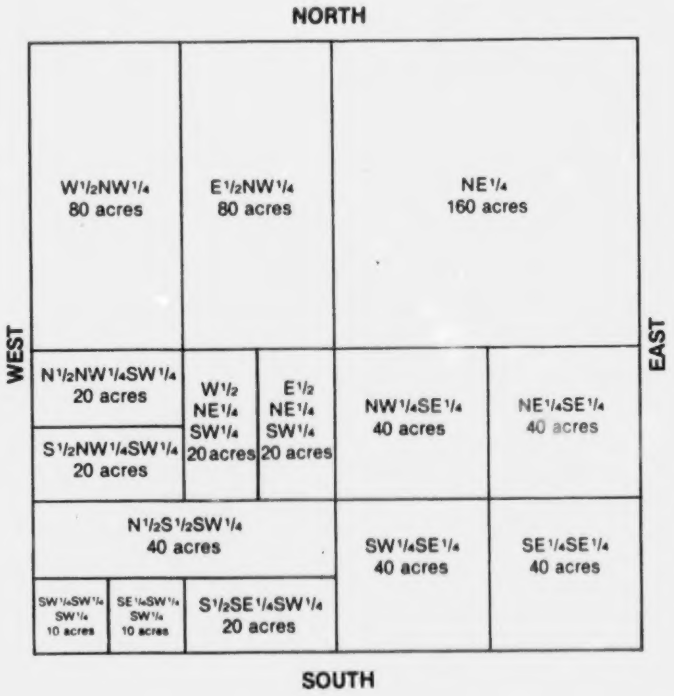
N

	6	5	4	3	2	1	
	7	8	9	10	11	12	
W	18	17	16	15	14	13	E
	19	20	21	22	23	24	
	30	29	28	27	26	25	
	31	32	33	34	35	36	

S

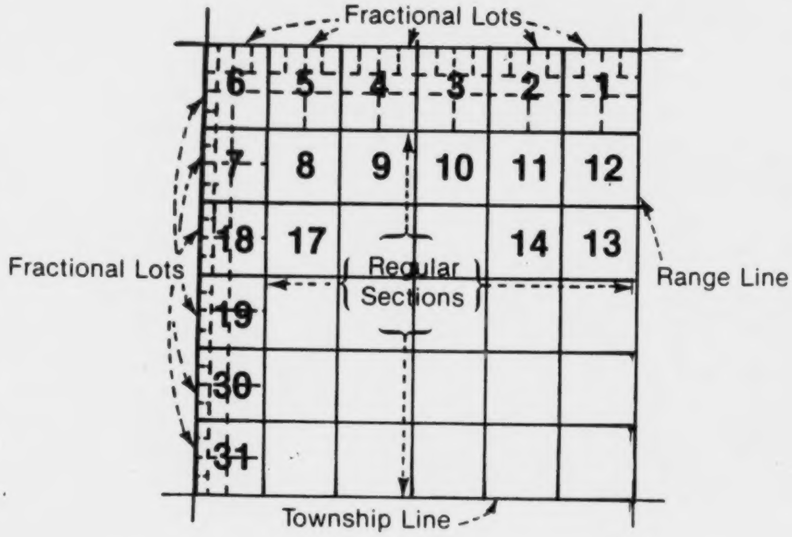
Numbered Section

- **Section subdivisions**—Tracts of 320, 160, 80, 40, 20, and 10 acres with descriptions in halves and quarters. (See Objective 6 for information on how to read the description.)


NORTH
W½NW¼ 80 acres
E½NW¼ 80 acres
NE¼ 160 acres
WEST
EAST
N½NW¼SW¼ 20 acres
S½NW¼SW¼ 20 acres
W½ NE¼ SW¼ 20 acres
E½ NE¼ SW¼ 20 acres
NW¼SE¼ 40 acres
NE¼SE¼ 40 acres
N½S½SW¼ 40 acres
SW¼SE¼ 40 acres
SE¼SE¼ 40 acres
SW¼SW¼ SW¼ 10 acres
SE¼SW¼ SW¼ 10 acres
S½SE¼SW¼ 20 acres
SOUTH

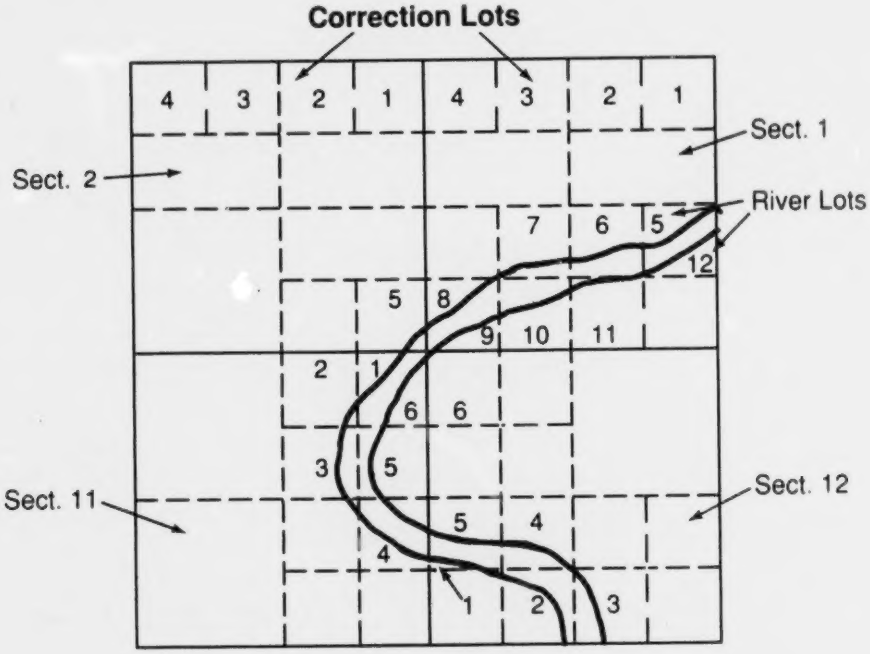
Section Subdivisions

- **Correction lots or Fractional sections**—Partial 40 acre lots are located on the north and west borders of a township to compensate for the lack of perfect squares due to the convergence of meridians and other causes. Correction lots are expected in counties bordering oceans, lakes and streams.


Fractional Lots
6
5
4
3
2
1
7
8
9
10
11
12
18
17
14
13
Fractional Lots
Regular Sections
Range Line
19
30
31
Township Line

Fractional Lots

- **River lots**—Lot numbers usually run downstream to a section line and then back upstream to the line.


Correction Lots
4
3
2
1
4
3
2
1
Sect. 1
Sect. 2
River Lots
7
6
5
12
5
8
9
10
11
2
1
6
6
3
5
Sect. 11
Sect. 12
5
4
4
1
2
3

River Lots

OBJECTIVE 6 **Choose the correct word or phrase to complete statements about reading USPLS system subdivision descriptions.** (Activity Sheet 1, Assignment Sheet 2)

- A full legal description goes from small divisions to increasingly larger divisions:
  - Lot
  - Quarter-quarter section (sixteenth section)
  - Quarter section
  - Half section
  - Section
  - Township and range
  - Principal meridian

EXAMPLE: All that part of the Northeast Quarter of the Northeast Quarter of Section 12, Township 5 North, Range 2 East of the Fifth Principal Meridian, Clarion Township, Walker county, and State of Missouri.

NE1/4 NE1/4 Section 12, T5N, R2E, 5th Principal Meridian

NOTE: In forestry, it's common to start with the section number.

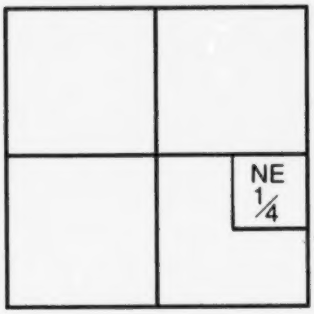
- It is easier to read and write legal descriptions from right to left (backwards).

EXAMPLE: NW1/4 SW1/4, W1/2 Section 6, T55N, R69W

Read as: Range 69 West, Township 55 North, Section 6, West half, Southwest quarter, Northwest quarter (of the southwest quarter)

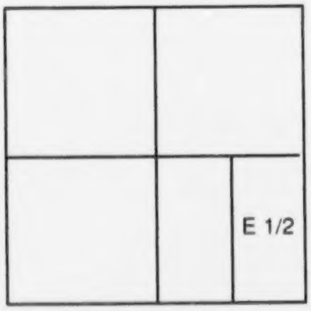
- Two letters alone means 1/4.

EXAMPLE: NE1/4 SE1/4 means the northeast quarter of the southeast quarter



- A single letter means 1/2.

EXAMPLE: E1/2 SE1/4 is combination of SE quarter and E half



- Acreage can be determined by the section subdivision. (See examples below)

  Section = 640 acres

  1/2 section = 320 acres

  1/4 section = 160 acres

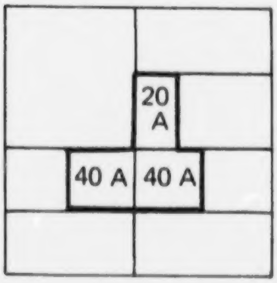
  1/2 of 1/4 = 80 acres

  1/4 of 1/4 = 40 acres

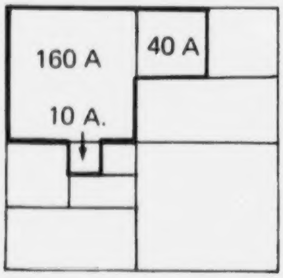
- Single-tract subdivisions are written as continuous descriptions; separate tracts are divided by one of the following:

  and, &, and **; (semicolon)**

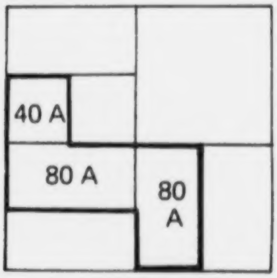
  EXAMPLES:



NE1/4 SW1/4; W1/2 SW1/4 NE1/4; NW1/4 SE1/4, Section 10

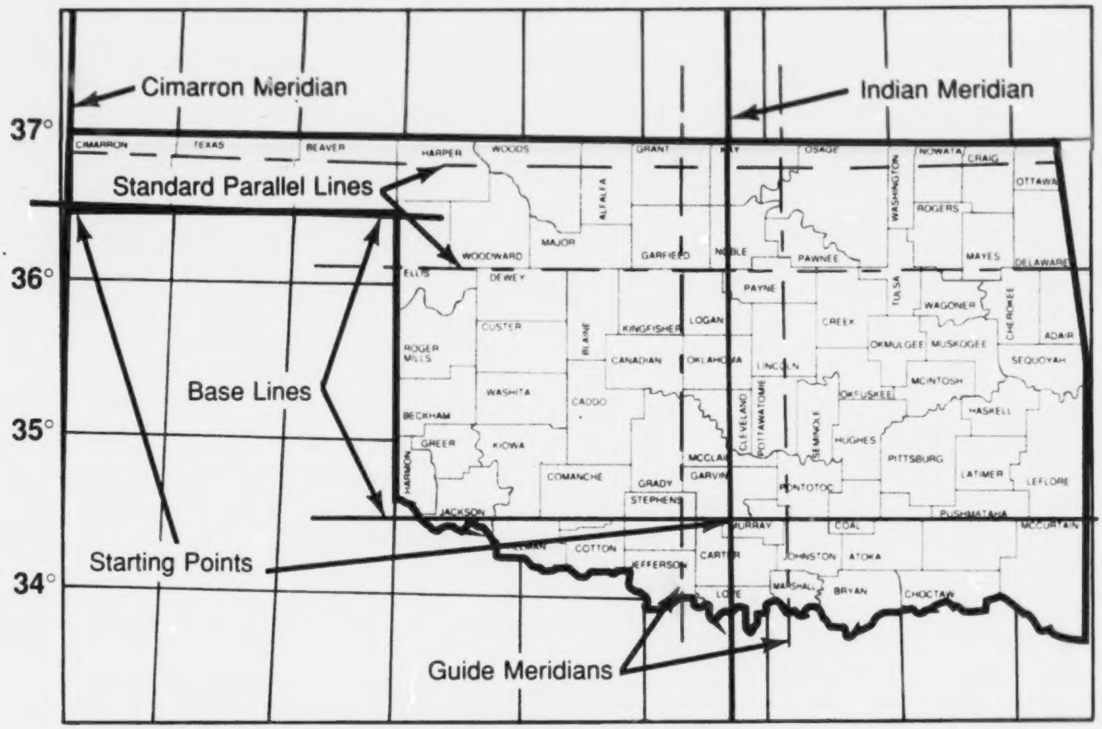


NW1/4 NE1/4 SW1/4; NW1/4; NW1/4 NE1/4, Section 10



N1/2 SW1/4; SW1/4 NW1/4; E1/2 SE1/4, Section 30

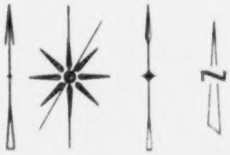
OBJECTIVE 7 | **Identify the principal meridians, base lines, and initial points in your state.**


Cimarron Meridian
Indian Meridian
37°
36°
35°
34°
Standard Parallel Lines
Base Lines
Starting Points
Guide Meridians
CIMARRON
TEXAS
BEAVER
HARPER
WOODS
ALFALFA
GRANT
KAY
OSAGE
NOWATA
CRAIG
OTTAWA
WASHINGTON
ROGERS
MAYES
DELAWARE
WOODWARD
MAJOR
GARFIELD
NOBLE
PAWNEE
TULSA
ELLIS
DEWEY
PAYNE
WAGONER
CHEROKEE
ADAIR
CUSTER
BLAINE
KINGFISHER
LOGAN
CREEK
OKMULGEE
MUSKOGEE
SEQUOYAH
ROGER MILLS
CANADIAN
OKLAHOMA
LINCOLN
MCINTOSH
WASHITA
CADDO
CLEVELAND
POTTAWATOMIE
SEMINOLE
OKFUSKEE
HASKELL
BECKHAM
GREER
KIOWA
HUGHES
PITTSBURG
HARMON
COMANCHE
GRADY
MCCLAIN
GARVIN
PONTOTOC
LATIMER
LEFLORE
STEPHENS
JACKSON
MURRAY
COAL
PUSHMATAHA
MCCURTAIN
TILLMAN
COTTON
JEFFERSON
CARTER
JOHNSTON
ATOKA
LOVE
MARSHALL
BRYAN
CHOCTAW

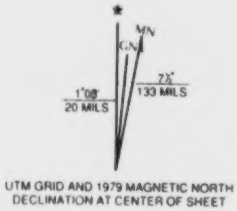
Location of the two principal meridians (—) and base lines (—) in Oklahoma. Two guide meridians (—-—) and two standard parallel lines (---) are also shown.

OBJECTIVE 8 | **Select from a list information found on a map legend.** (Assignment Sheet 4)

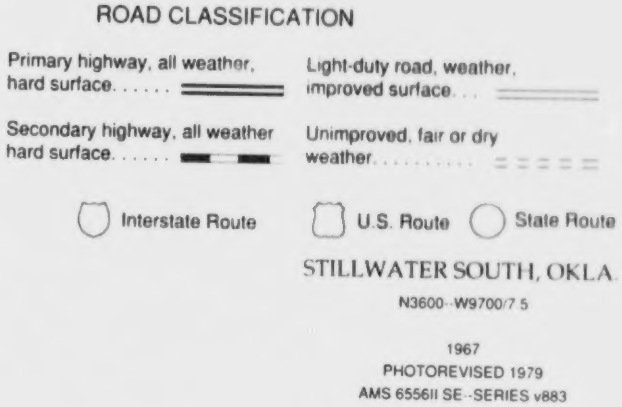
- True north arrow



- Magnetic north arrow on topographic maps

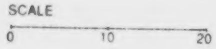

MN
GN
1°08'
20 MILS
7½°
133 MILS
UTM GRID AND 1979 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET

- Highway and road classification symbols


ROAD CLASSIFICATION
Primary highway, all weather, hard surface
Light-duty road, weather, improved surface
Secondary highway, all weather hard surface
Unimproved, fair or dry weather
Interstate Route
U.S. Route
State Route
STILLWATER SOUTH, OKLA.
N3600--W9700/7.5
1967
PHOTOREVISED 1979
AMS 6556II SE--SERIES v883

- Scale—Shows the proportion that distance on the map bears to actual distance, such as 1" equals 14 miles

EXAMPLE:

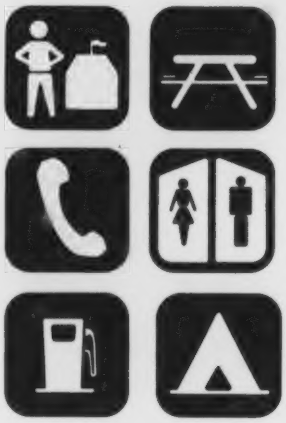

SCALE
0
10
20

Highway Map Scale

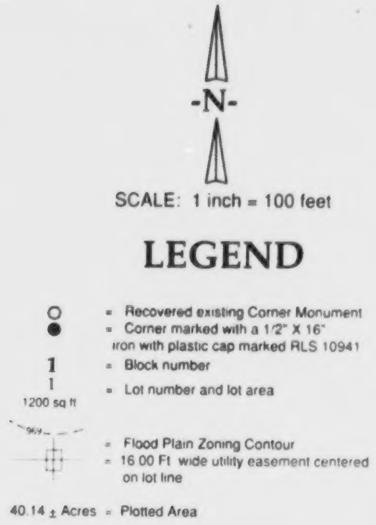
- Scales for USGS Topographic Map series. Available in different scales, used for different purposes. The higher the number, the larger the area covered.

- Other symbols, depending on the purpose of the map

EXAMPLES:



Legend From A Tourist Map Of A National Park Indicating Services Available In The Park

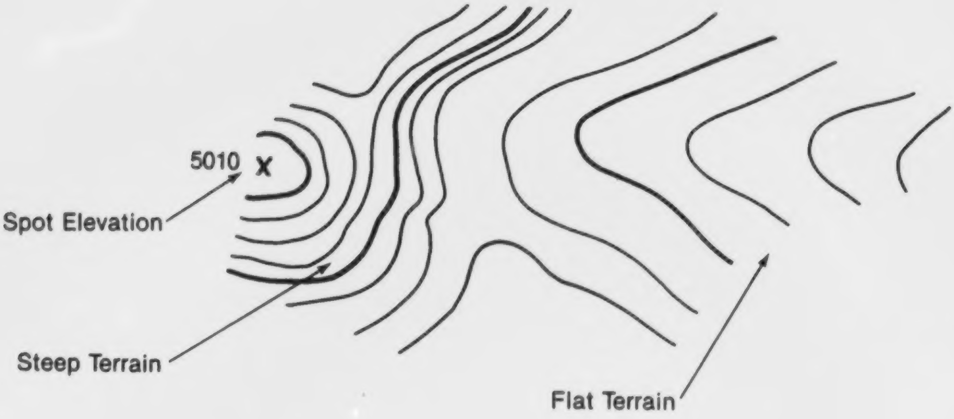

-N-
SCALE: 1 inch = 100 feet
LEGEND
= Recovered existing Corner Monument
= Corner marked with a 1/2" X 16" iron with plastic cap marked RLS 10941
1 = Block number
1 1200 sq ft = Lot number and lot area
969
= Flood Plain Zoning Contour
= 16.00 Ft wide utility easement centered on lot line
40.14 ± Acres = Plotted Area

Legend From A Plat Of A City Subdivision

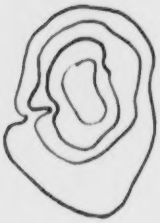
OBJECTIVE 9 **Label contour configurations.** (Assignment Sheet 4)

NOTE: Elevations are listed for each quarter section.

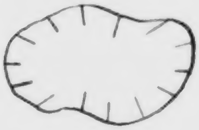
- **Steep and flat terrain.**


5010 X
Spot Elevation
Steep Terrain
Flat Terrain

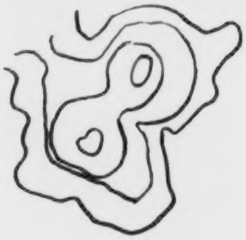
- **Summit**



- **Depression**

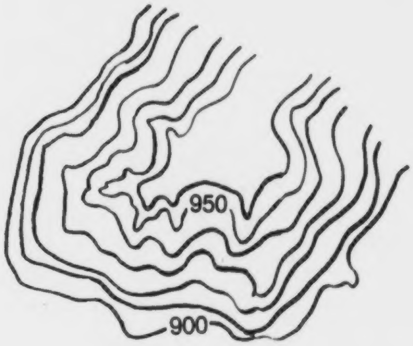


- **Saddle**



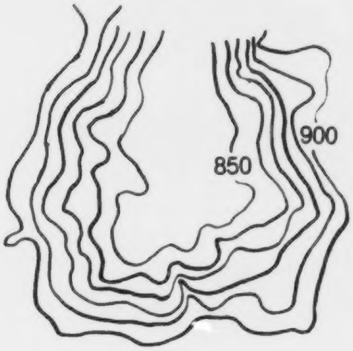
- **Ridge**

NOTE: Notice that the elevation increases toward the center.

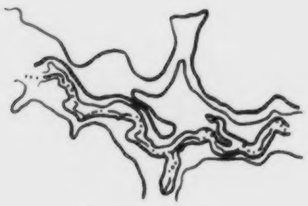


- **Valley**

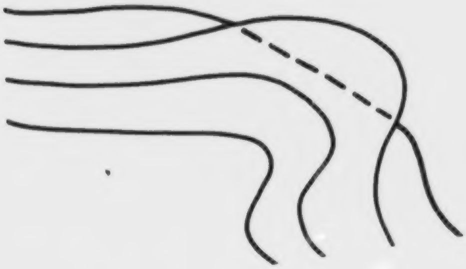
NOTE: Notice that the elevation decreases toward the center.



- **Stream**



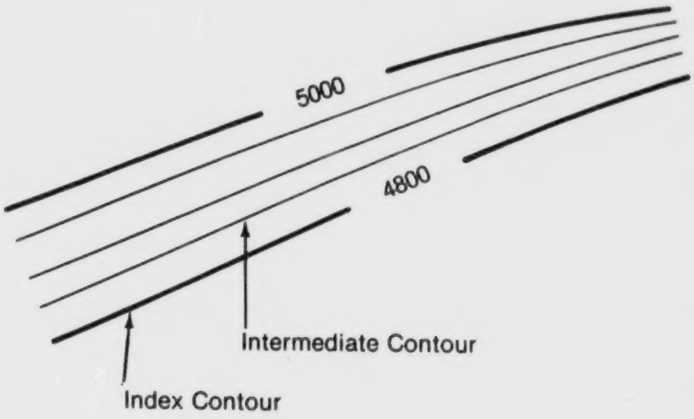
- **Overhang or cliff**



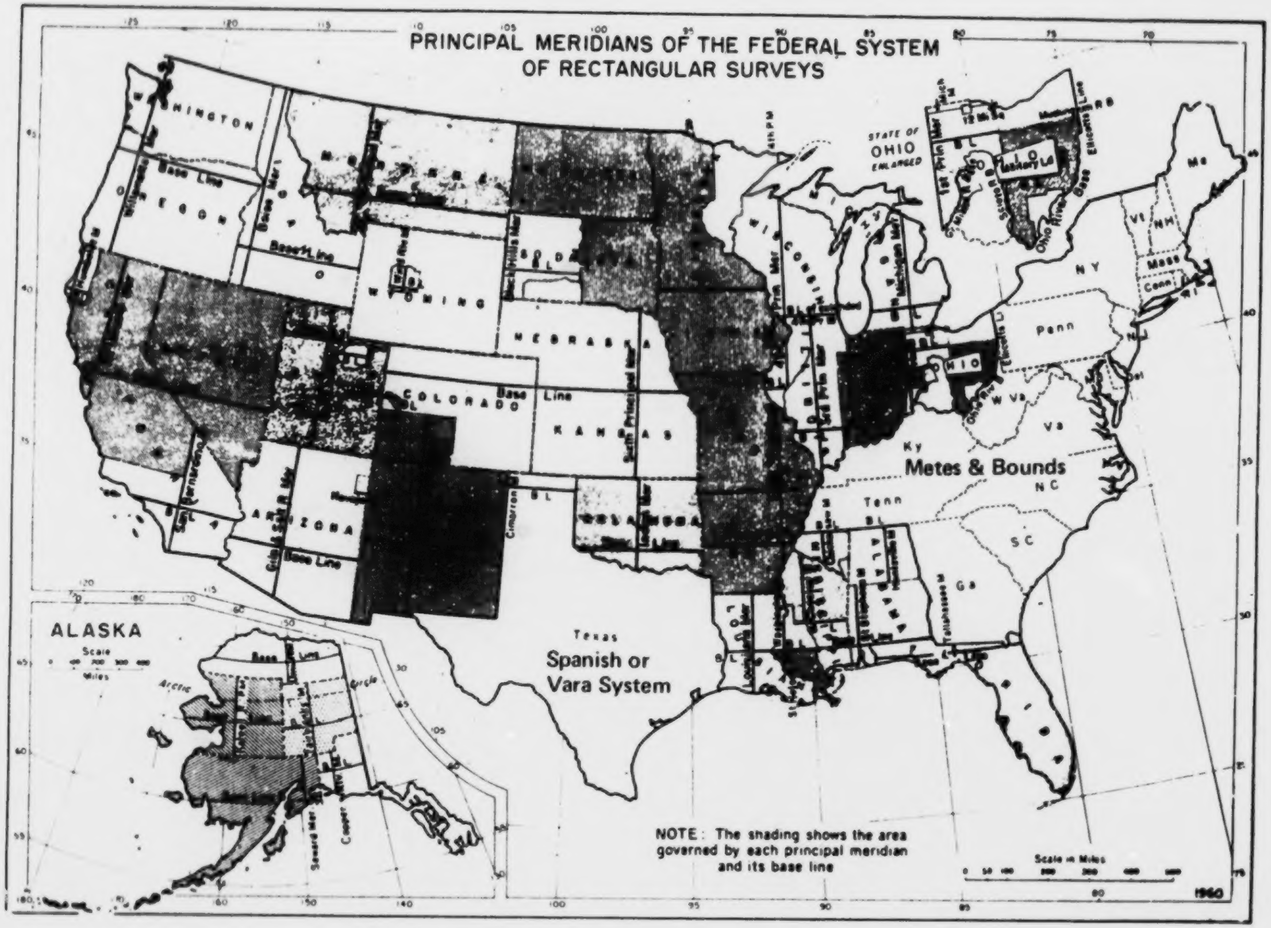
798

- **Index and intermediate contours**

  NOTE: Index contours are heavier lines and will have the elevation marked. Intermediate contours are lighter lines representing each increase in elevation.


5000
4800
Intermediate Contour
Index Contour

LAND SURVEY SYSTEMS



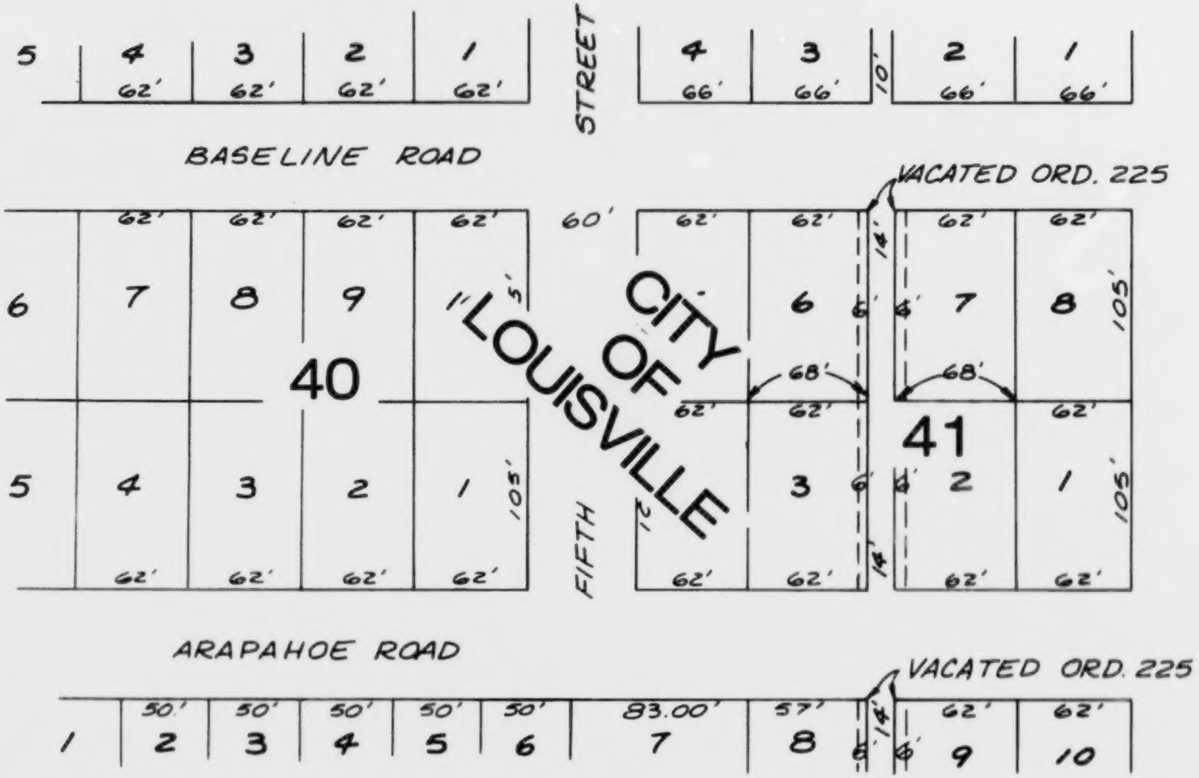
PRINCIPAL MERIDIANS OF THE FEDERAL SYSTEM OF RECTANGULAR SURVEYS

WASHINGTON
OREGON
Willamette Mer
Base Line
Boise Mer
MONTANA
WYOMING
Wind River Mer
SO DAKOTA
Black Hills Mer
NEBRASKA
Sixth Principal Mer
COLORADO
Base Line
KANSAS
ARIZONA
Gila & Salt R Mer
Base Line
Cimarron Mer
OKLAHOMA
WISCONSIN
Michigan Mer
STATE OF OHIO ENLARGED
OHIO
Me
Vt
NH
Mass
Conn
NY
Penn
Del
W Va
Va
Ky
Metes & Bounds
N C
Tenn
S C
Ga
ALABAMA
Texas
Spanish or Vara System
ALASKA
Scale
Miles
Arctic
Circle
Base Line
Seward Mer
Copper River Mer
Scale in Miles
1960

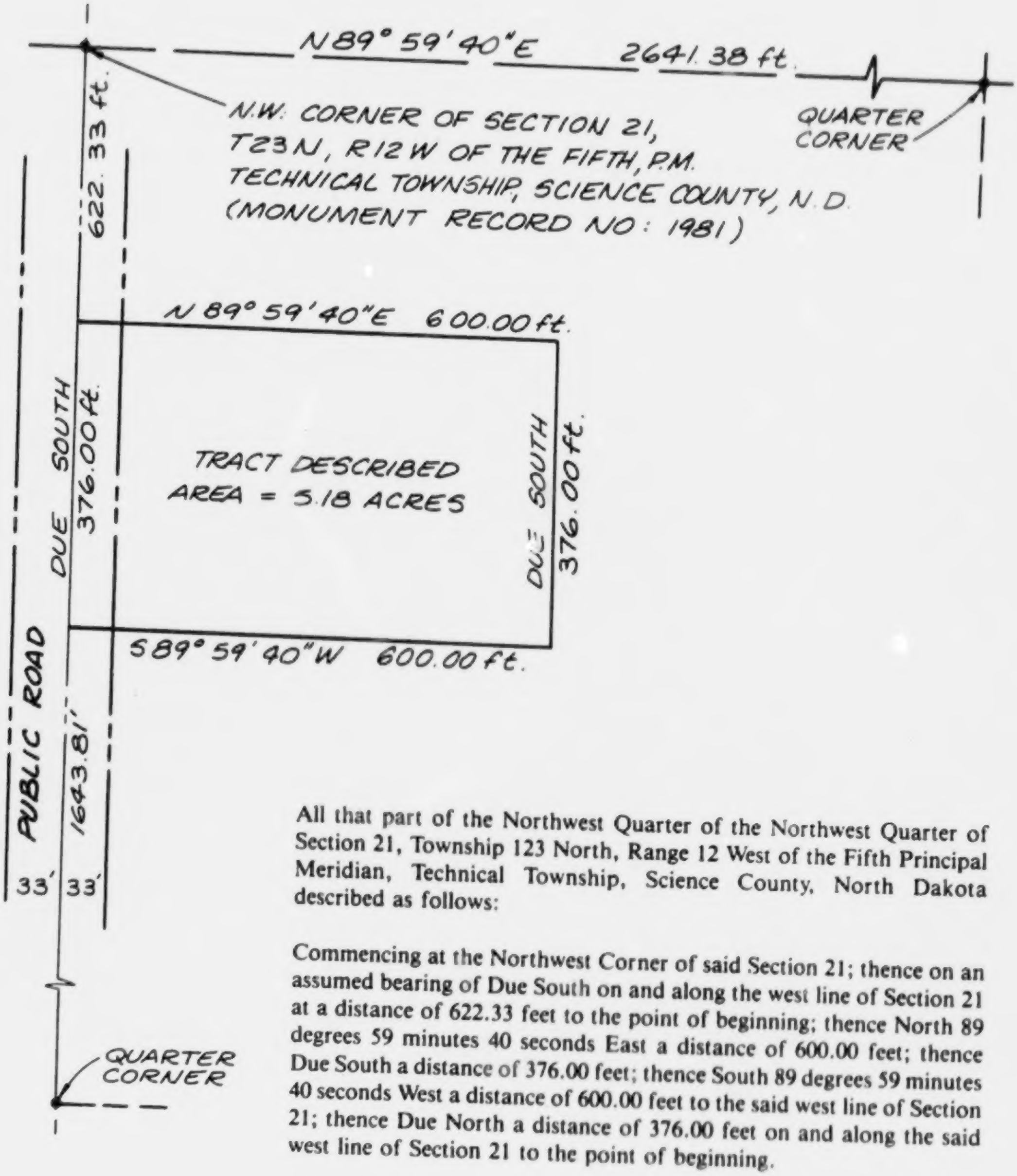
NOTE: The shading shows the area governed by each principal meridian and its base line

LOT AND BLOCK DESCRIPTION

LOT 8, BLOCK 40, BOULDER SUBDIVISION, CITY OF LOUISVILLE, BOULDER COUNTY STATE OF COLORADO


5
4
3
2
1
62'
62'
62'
62'
STREET
4
3
2
1
66'
66'
10'
66'
66'
BASELINE ROAD
VACATED ORD. 225
62'
62'
62'
62'
60'
62'
62'
14'
62'
62'
6
7
8
9
6
6'
6'
7
8
105'
40
CITY OF LOUISVILLE
68'
68'
62'
62'
41
62'
5
4
3
2
1
105'
FIFTH
3
2
1
105'
62'
62'
62'
62'
62'
62'
14'
62'
62'
ARAPAHOE ROAD
VACATED ORD. 225
50'
50'
50'
50'
50'
83.00'
57'
14'
62'
62'
1
2
3
4
5
6
7
8
6'
6'
9
10

TYPICAL METES AND BOUNDS DESCRIPTION

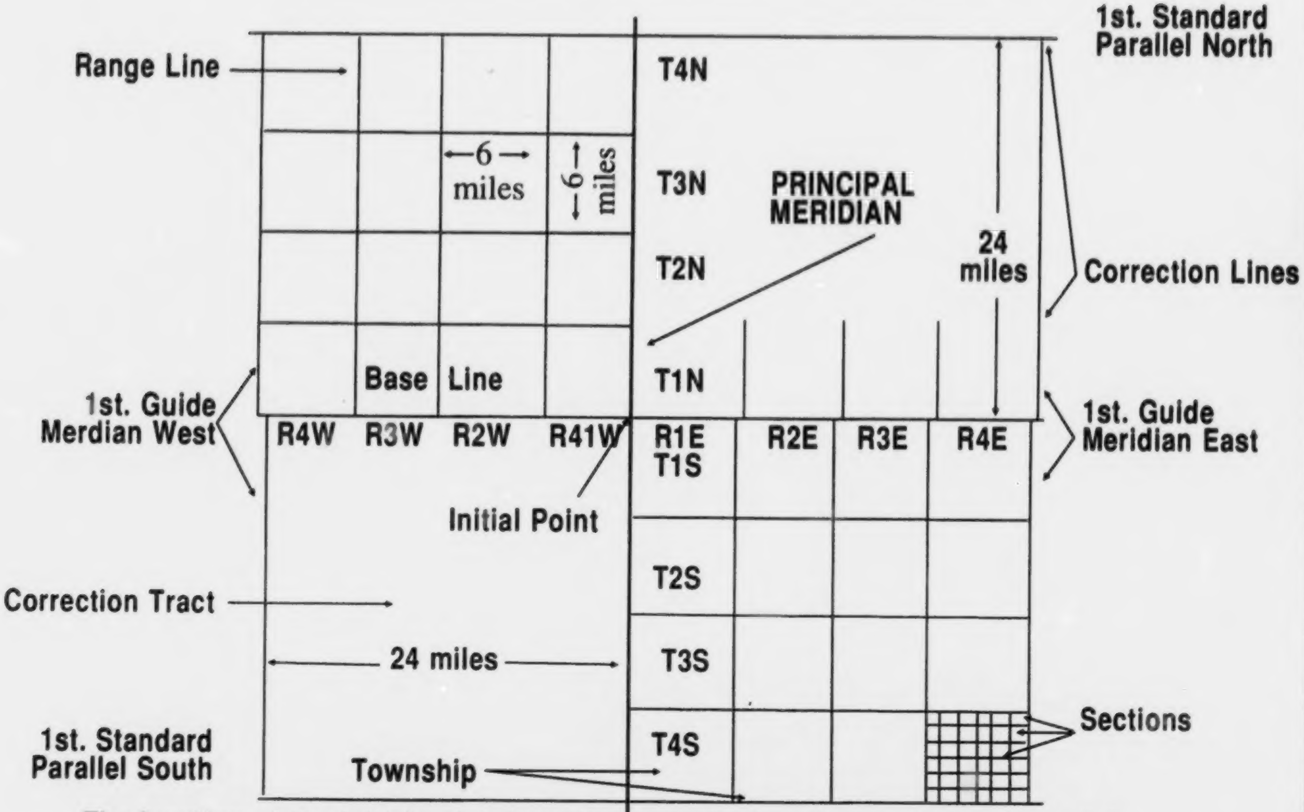

N 89° 59' 40" E 2641.38 ft.
N.W. CORNER OF SECTION 21,
T23N, R12W OF THE FIFTH, P.M.
TECHNICAL TOWNSHIP, SCIENCE COUNTY, N.D.
(MONUMENT RECORD NO: 1981)
QUARTER CORNER
622.33 ft.
N 89° 59' 40" E 600.00 ft.
DUE SOUTH 376.00 ft.
TRACT DESCRIBED
AREA = 5.18 ACRES
DUE SOUTH 376.00 ft.
S 89° 59' 40" W 600.00 ft.
PUBLIC ROAD
1643.81'
33'
33'
QUARTER CORNER

All that part of the Northwest Quarter of the Northwest Quarter of Section 21, Township 123 North, Range 12 West of the Fifth Principal Meridian, Technical Township, Science County, North Dakota described as follows:

Commencing at the Northwest Corner of said Section 21; thence on an assumed bearing of Due South on and along the west line of Section 21 at a distance of 622.33 feet to the point of beginning; thence North 89 degrees 59 minutes 40 seconds East a distance of 600.00 feet; thence Due South a distance of 376.00 feet; thence South 89 degrees 59 minutes 40 seconds West a distance of 600.00 feet to the said west line of Section 21; thence Due North a distance of 376.00 feet on and along the said west line of Section 21 to the point of beginning.

The above described tract contains 5.18 acres more or less and is subject to an existing public road over and across its most westerly 33.00 feet.

RECTANGULAR SYSTEM SUBDIVISIONS


1st. Standard Parallel North
Range Line
T4N
←6→ miles
←6→ miles
T3N
PRINCIPAL MERIDIAN
24 miles
T2N
Correction Lines
T1N
Base Line
1st. Guide Merdian West
1st. Guide Meridian East
R4W
R3W
R2W
R41W
R1E
R2E
R3E
R4E
T1S
Initial Point
T2S
Correction Tract
24 miles
T3S
Sections
T4S
1st. Standard Parallel South
Township

The location of the initial point, base line, principal meridian, standard parallels, guide meridians, ranges, townships, and sections.

LAND LOCATION MARKINGS

Survey line markings

- Townships—Three blazes and hacks
- Sections—Two blazes and hacks
- Section subdivisions—One blaze and hack

NOTE: To mark trees on a survey line, surveyors use a hack on each side of trees intersected with a survey line. They put blazes on adjacent trees facing the survey line. Different-colored paint markings are also used: The U.S. Forest Service uses red; Weyerhaueser uses white exterior lines and orange interior lines; and other landowners use various colors. There is no standard.

Corner markings in legal survey

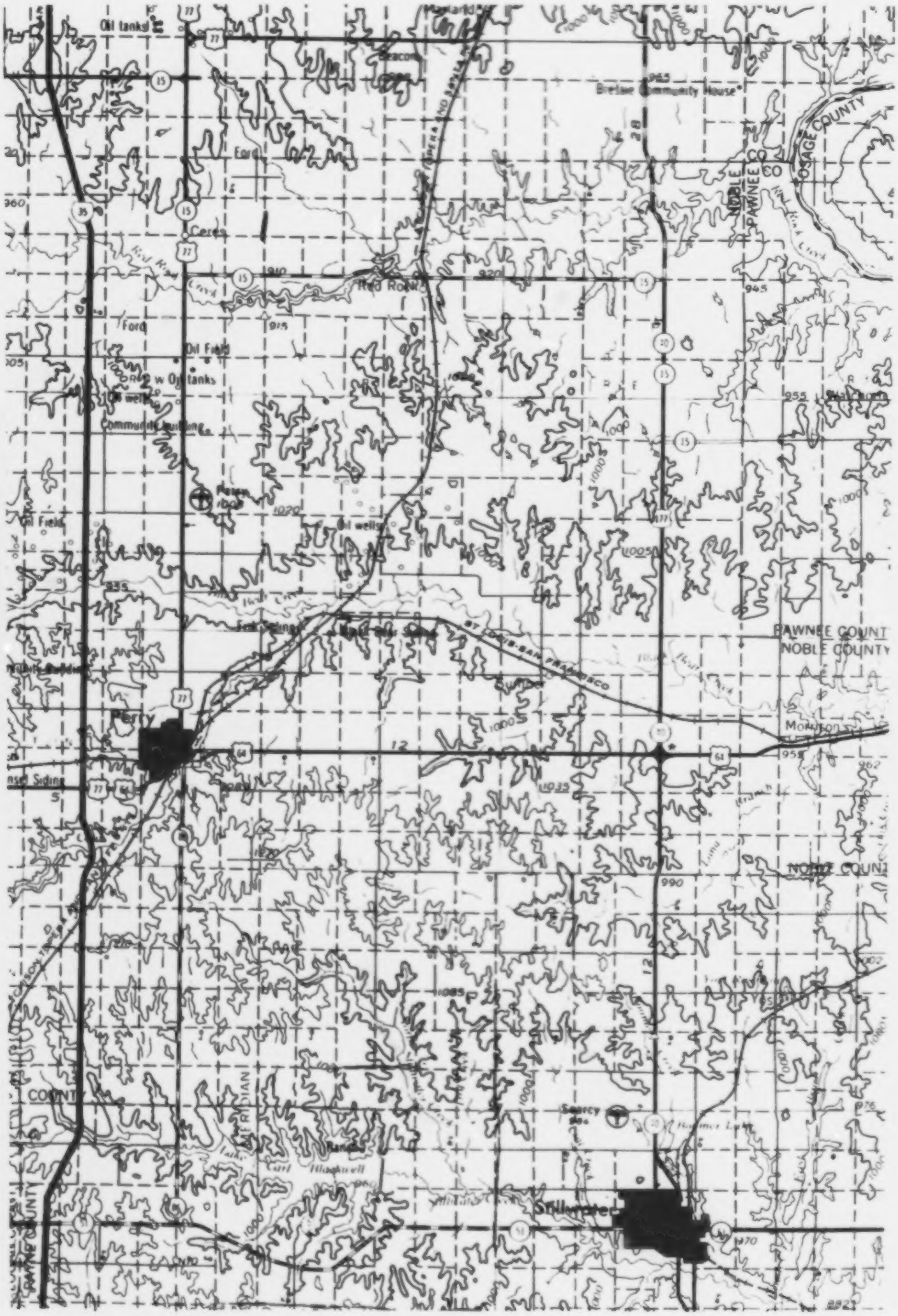
Usually, the monument is marked sandstone, but it may be charred stakes, buried charcoal, glassware, pieces of metal, or any durable material not found in nature.

- Township corners—Placed every mile and one-half mile; marked on two sides along with the direction of survey with one notch for each mile of distance to the next intersecting township line.
- Section corner—Marked at the southeast corner of the township. Horizontal marks placed on the south and east face of a rock with one mark for each mile of distance to the SE corner of the township.
- Quarter corners
  - East-West lines are marked "1/4" on the north face
  - North-South lines are marked "1/4" on the west face
- Legal resurveyed corners—Iron pipe with brass cap tooled (engraved) with township, section, or 1/4 corner represented.

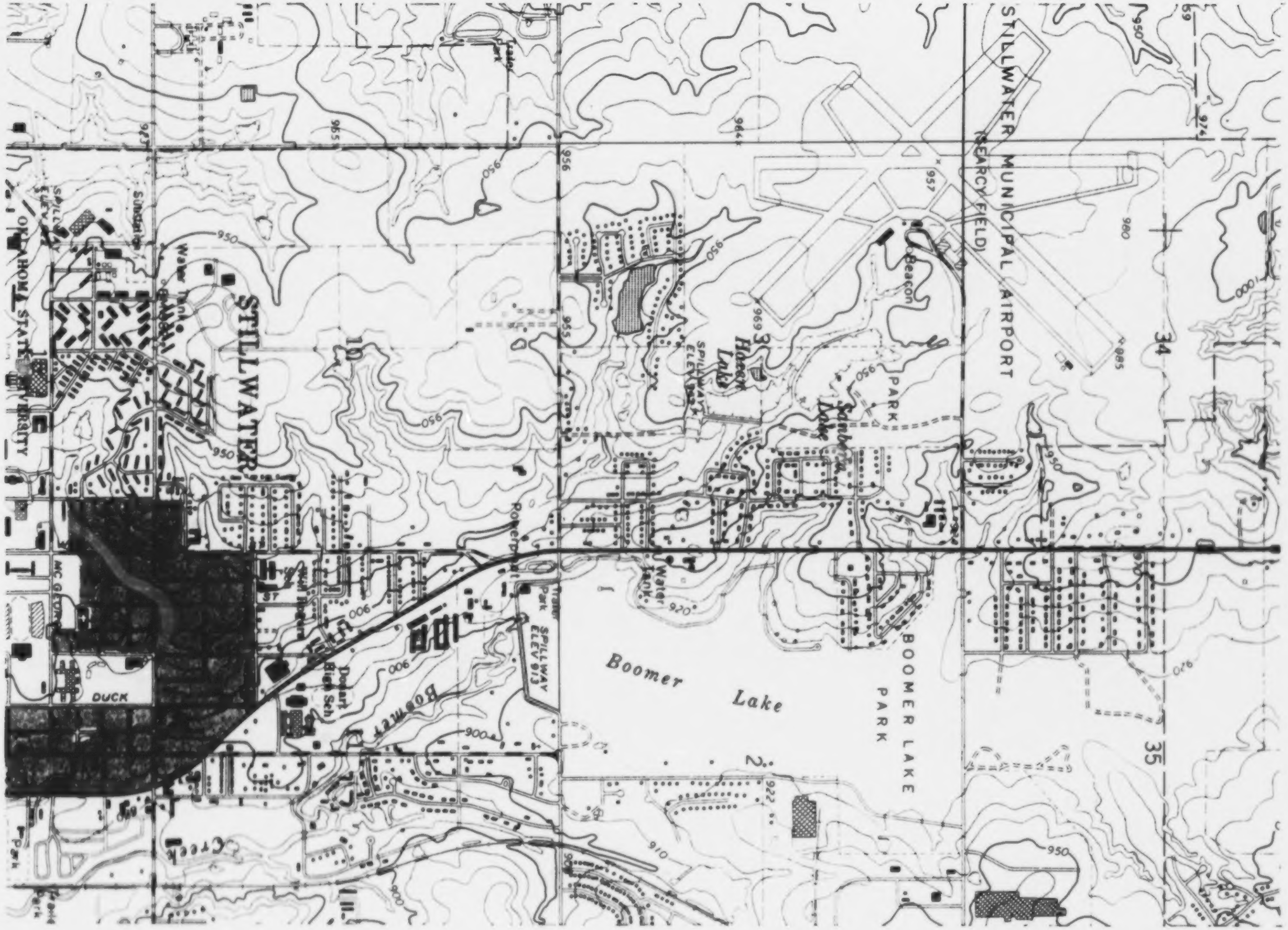
Witness markings—The location is referred to in field notes, so it is "witnessed" and described as an identifying marker: "8 ch W of mound of stones."

- Bearing trees
- Bearing object—May be a natural rock formation, railroad trestle, mound of stone, or other durable material chiseled with an "X" or "BO." The distance and bearing is recorded in the field notes.

1:250 000-SCALE MAP


Oil tanks
Beacon
Bretae Community House
Ford
Ceres
Red Rock
Oil Field
Oil tanks
Oil wells
Community building
Oil wells
Perry
Sumner
Morrison
PAWNEE COUNTY
NOBLE COUNTY
NOBLE CO
PAWNEE CO
OSAGE COUNTY
ST LOUIS-SAN FRANCISCO
MERIDIAN
Searcy
Stillwater
COUNTY
PAYNE COUNTY

1:24 000 SCALE MAP

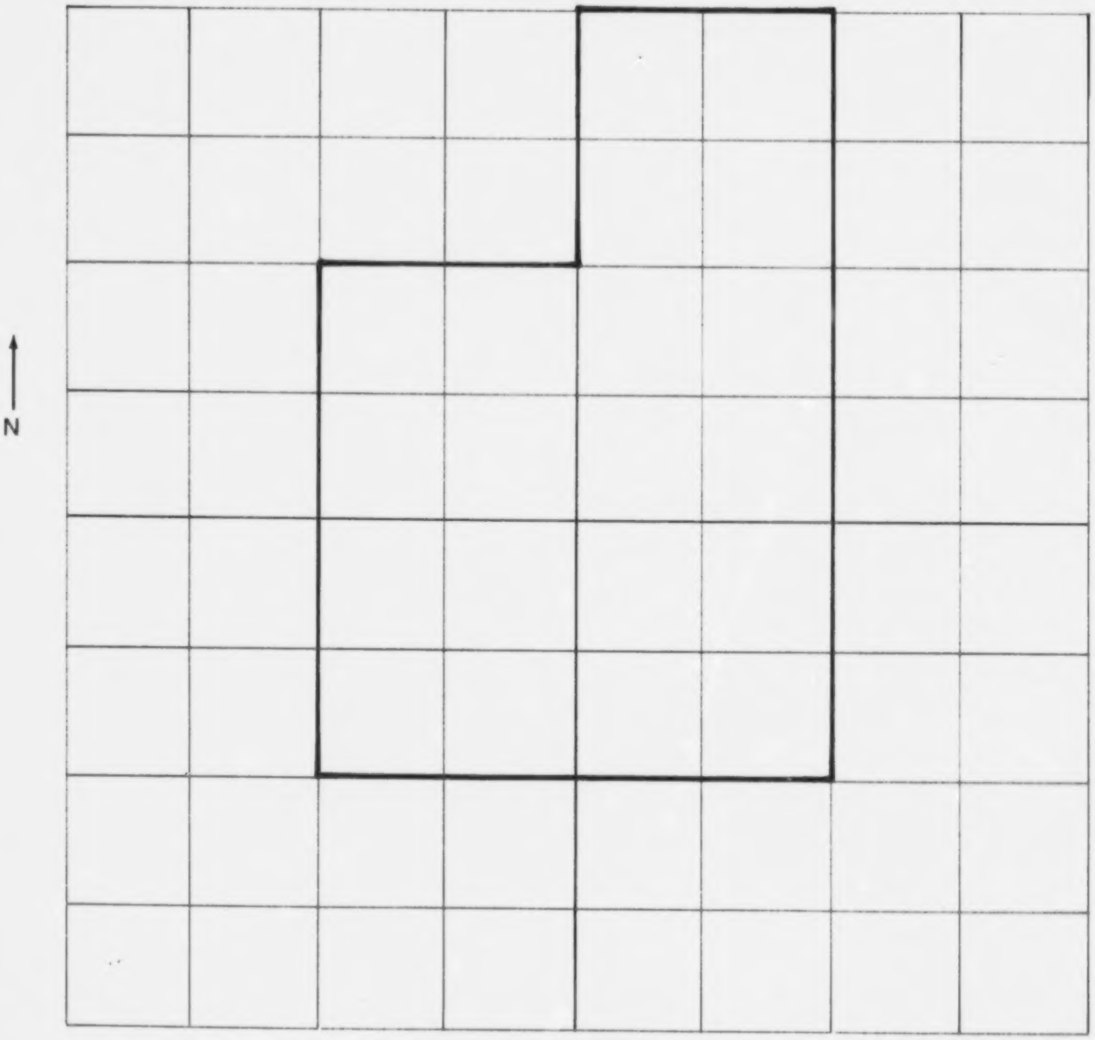

STILLWATER
STILLWATER MUNICIPAL AIRPORT
(SEARCY FIELD)
OKLAHOMA STATE UNIVERSITY
Boomer Lake
BOOMER LAKE PARK
PARK
Boomer
Creek
Beacon
Water Tank
SPILLWAY ELEV 913
Trailer Park
DUCK
34
35
10
3
2
950
900
957
980
974
920
922

PRACTICE INTERPRETING LEGAL DESCRIPTIONS

1. Using the plat sheet sketch of a section below, determine the total acres in the tract and its complete legal description.

   a. Acres______________________________________

   b. Description__________________________________



Scale 6" = 1 Mile

2. Suppose the landowner in the first problem bought 100 acres of land with the following legal description:

   NE1/4 NW1/4 and SW1/4 NW1/4 and S1/2 NW1/4 NW1/4, Section 16, T6N, R19E

   Mark an "X" in the additional acres on the plat sheet.

3. How many acres are in the following described tracts? You may use the section maps on the next page to help work out your answers.

   a. SW1/4 and N1/2 Section 2 ________

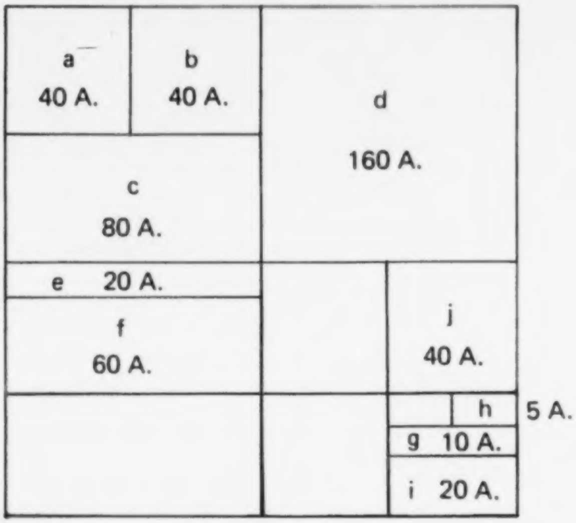
   b. S1/2 S1/2 SE1/4 and S1/2NE1/4 Section 14 _______

   c. SE1/4; SE1/4 SW1/4 SW1/4, Section 3, and N1/2 NW1/4, Section 2 _________

   d. W1/2, Section 6, and NW1/4 NW1/4 NW1/4, Section 7

   e. N1/2 SE1/4 and SW1/4, Section 33 and 34 _________

4. Describe in legal terms the fractional parts of the following


a
40 A.
b
40 A.
d
160 A.
c
80 A.
e 20 A.
f
60 A.
j
40 A.
h
5 A.
g 10 A.
i 20 A.

a.

b.

c.

d.

e.

f.

g.

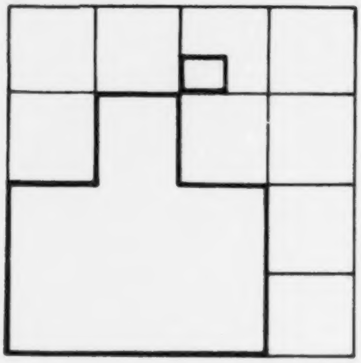
h.

i.

j.

5. What is the legal description for the following sketch of property?

Section 11, T3N, R19E



RETRACE BOUNDARIES FROM A DEED DESCRIPTION

TOOLS AND MATERIALS

- Compass
- Chain
- Flagging tape
- Small shovel
- Field book and pencil or pen
- Copy of deed description
- Topographic map of the area (optional)
- Metal detector (optional)

PROCEDURE

1. Obtain a copy of a deed from someone you know or from your local county courthouse or register of deeds.
2. Obtain permission to go onto the property and retrace the boundary lines.
3. Locate the parcel of land and briefly note any fences, agricultural markings, hedges, etc. that can sometimes indicate ownership.
4. Begin to retrace the property by locating one of the property corners and verifying its position.

   NOTE: The corner could be below grade. A metal detector may be needed to find buried metal corner markers.
5. Once this corner is found and marked, use the copy of the deed to retrace the distance and angle or bearing recorded on it to establish the next corner.
6. Record your bearing, direction, markers, and additional landmarks in your field notes.

7. Repeat this process from corner to corner around the outside of the tract until the job is finished.

NOTE: Sometimes all markers cannot be found or may have been destroyed. Resetting of any corners should only be done by registered land surveyors.

DRAW A MAP OF YOUR NEIGHBORHOOD

If you wish, you can obtain a copy of the plat of your neighborhood from your county courthouse. Or you can draw a map of your own design. You can use graph paper for an accurate scale, or you can get a topographic map and represent the elevations in different colors. Using paper mache, salt and soda, clay, bread dough, or cornstarch clay, and paint, you could make a 3-dimensional topographic map.

You may use USPLS symbols or symbols of your own design.

Include:

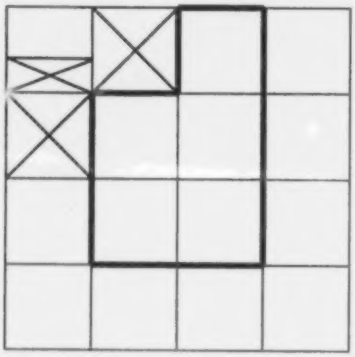
- North Arrow
- Scale
- North, south, east and west boundaries
- Important landmarks such as schools, churches etc.
- Roads, streams, railroads, etc.
- Buildings
- Fences
- Legend

ACTIVITY SHEET 1

1. a. 200

   b. NW1/4 SE1/4; W1/2 NE1/4; SE1/4 NW1/4; NE1/4 SW1/4

2.



3. a. 480

   b. 120

   c. 250

   d. 330

   e. 480

4. a. NW1/4 NW1/4

   b. NE1/4 NW1/4

   c. S1/2 NW1/4

   d. NE1/4

   e. N1/2 N1/2 N1/2 SW1/4

   f. S1/2 N1/2 N1/2 SW1/4 and S1/2 N1/2 SW1/4

   g. S1/2 N1/2 SE1/4 SE1/4

   h. E1/2 N1/2 N1/2 SE1/4 SE1/4

   i. S1/2 SE1/4 SE1/4

   j. NE1/4 SE1/4

5. SW1/4 NW1/4 NE1/4; SE1/4 NW1/4; SW1/4; W1/2 SE1/4, Section 11, T3N, R19E

ASSIGNMENT SHEET 1

USE LEGAL LAND DESCRIPTIONS

XI

NAME ______________________ SCORE ________

OBJECTIVE 10 **Identify subdivisions of the USPLS System.**

INTRODUCTION The USPLS System is used across the country.

DIRECTIONS Use Supplement 4 to complete the following questions.

1. Write the legal description of the townships below. The first one is done for you as an example.

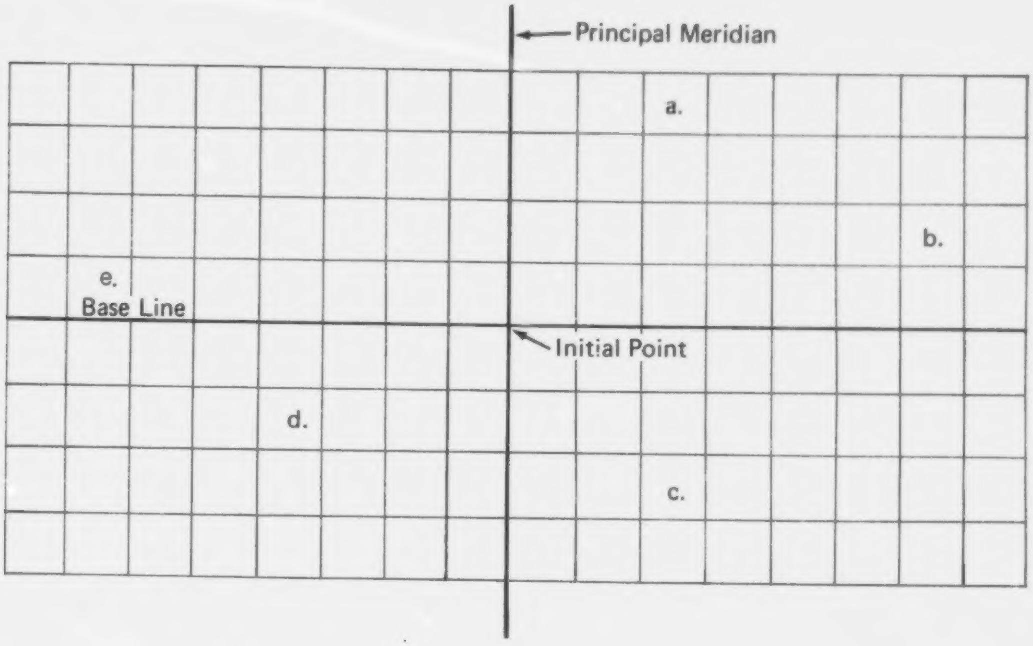
   a. T4N, R3E

   b. ______________

   c. ______________

   d. ______________

   e. ______________


Principal Meridian
a.
b.
e.
Base Line
Initial Point
d.
c.

2. Write the correct section numbers in the township below.

3. Write the correct section numbers for the sections marked below.

a. ______

b. ______

c. ______

d. ______

e. ______

			a		
	b				
c					
d					e

ASSIGNMENT SHEET 2

USE LEGAL LAND DESCRIPTIONS

XI

NAME ______________________ SCORE ______

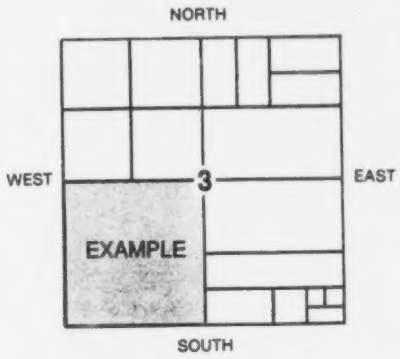
OBJECTIVE 11 **Interpret descriptions for the subdivision of a section.**

INTRODUCTION

If you live in the country or in a rural community, you understand the importance of phrases like, "the north 40," and "the SE corner." Knowing the subdivisions of a section are necessary for basic communication about land and land locations. This assignment sheet will help you master the ways to write and locate legal land descriptions.

DIRECTIONS Refer to Objective 6 to complete Part 1 and Part 2 as indicated.

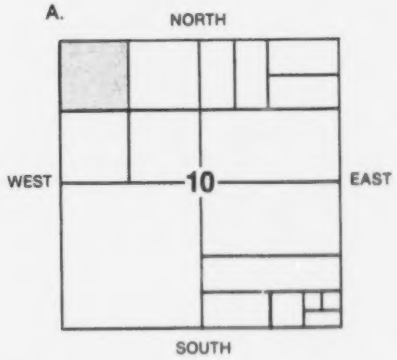
PART 1—Write descriptions for the subdivision of a section and determine the acreage as shown in the example:


NORTH
WEST
3
EAST
EXAMPLE
SOUTH

SW 1/4, SECTION 3

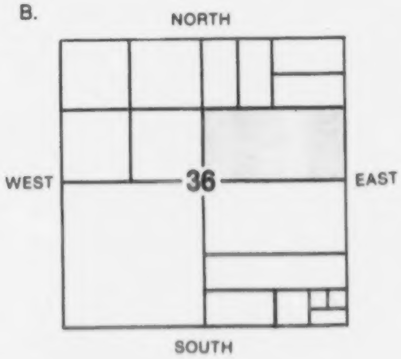
ACRES: 160

A.


NORTH
WEST
10
EAST
SOUTH

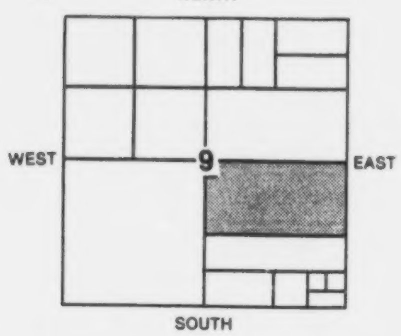
ACRES:

B.


NORTH
WEST
36
EAST
SOUTH

ACRES:

C.

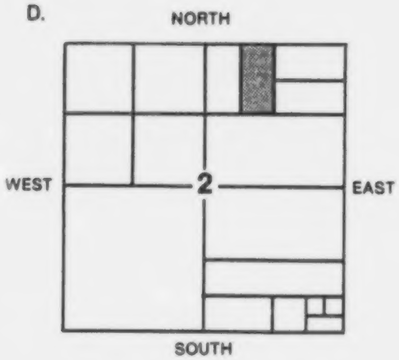

NORTH
WEST
9
EAST
SOUTH

____

____

ACRES: ______________________

D.

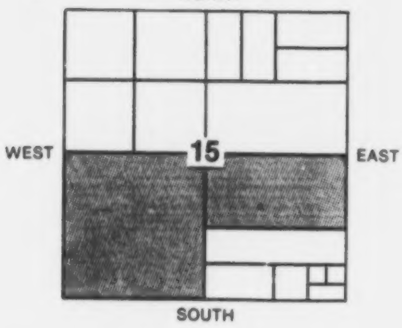

NORTH
WEST
2
EAST
SOUTH

____

____

ACRES: ______________________

E.

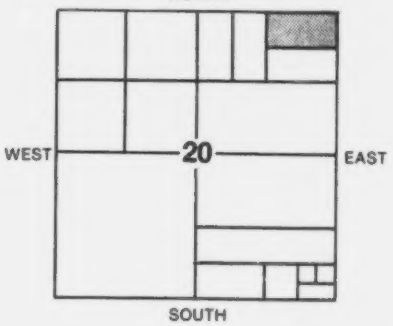

NORTH
WEST
15
EAST
SOUTH

____

____

ACRES: ______________________

F.


NORTH
WEST
20
EAST
SOUTH

____

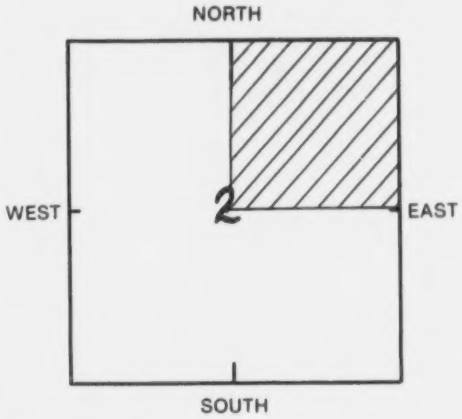
____

ACRES: ______________________

PART 2—Locate subdivisions in a section

The illustrations represent sections and legal descriptions. For each:

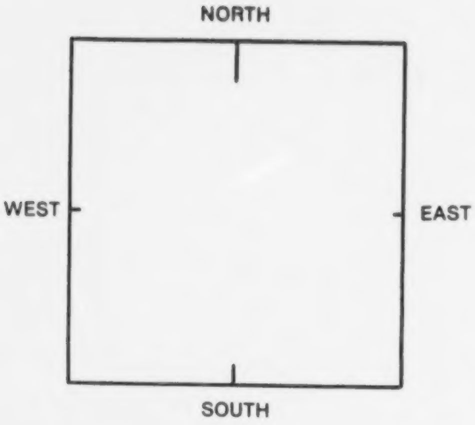
1. Label the section number in the center of the section
2. Subdivide each section according to the legal description. Shade the area.
3. Give the acreage of the shaded area in the space provided.



ACRES: 160

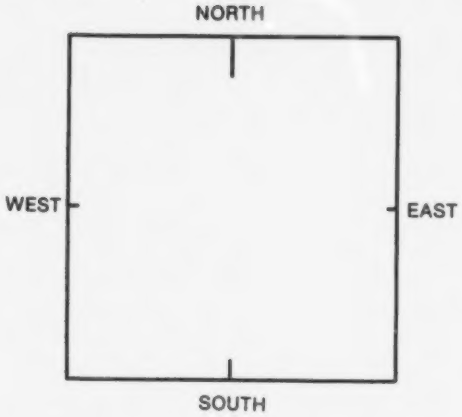
Example: NE1/4, Section 2

A. SE1/4 SE1/4, Section 10


NORTH
WEST
EAST
SOUTH

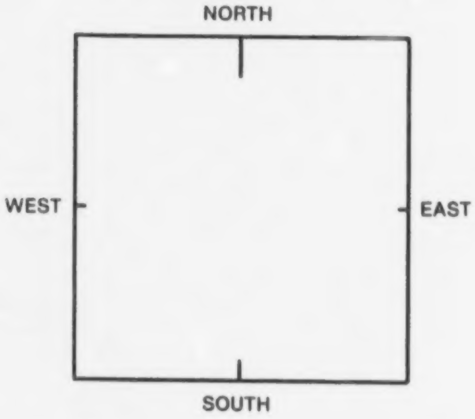
ACRES:____________________

B. N1/2, NE1/4, Section 31


NORTH
WEST
EAST
SOUTH

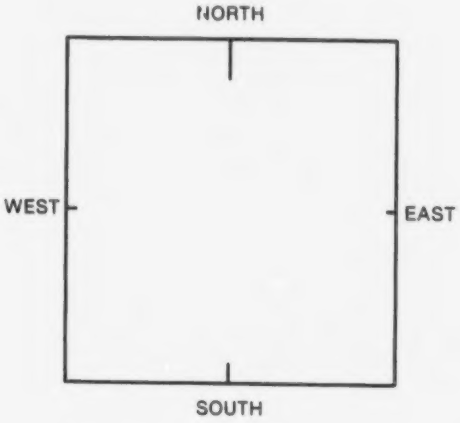
ACRES:____________________

C. SW1/4, NW1/4, SW1/4, Section 7


NORTH
WEST
EAST
SOUTH

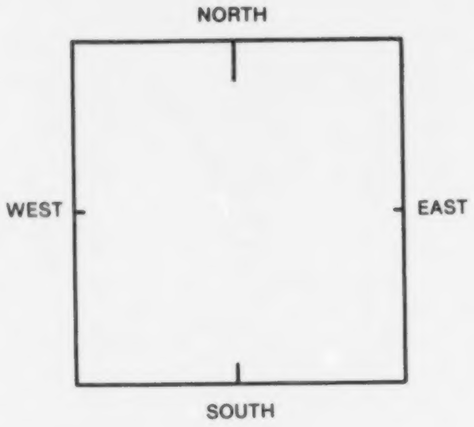
ACRES:____________________

D. SE1/4 & S1/2 NE1/4, Section 23


NORTH
WEST
EAST
SOUTH

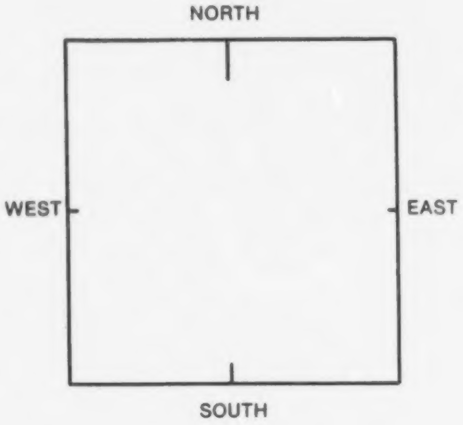
ACRES:____________________

E. N1/2, Section 5


NORTH
WEST
EAST
SOUTH

ACRES:____________________

F. SE1/4, NE1/4, SW1/4, Section 16


NORTH
WEST
EAST
SOUTH

ACRES:____________________

ASSIGNMENT SHEET 3 — USE LEGAL LAND DESCRIPTIONS — XI

NAME ______________________________ SCORE ________

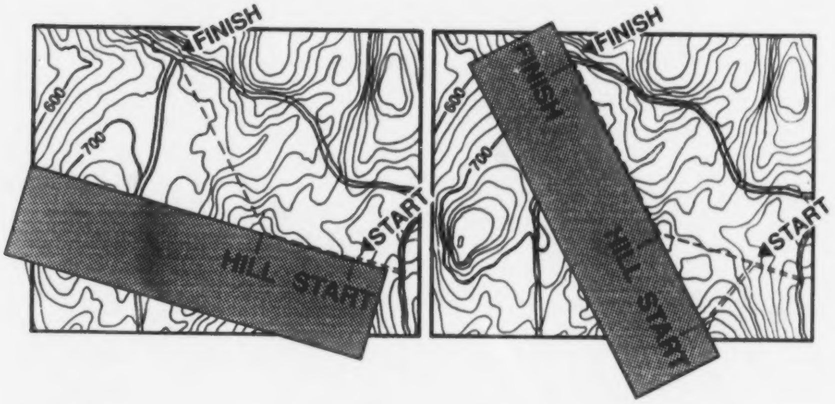
OBJECTIVE 12 **Determine distance and direction on a topographic map.**

INTRODUCTION

Here is a 5 mile hike that might be a boundary check, a timber cruise, a survey for insect or disease damage, or an afternoon outing. Use this assignment sheet to gain skills in figuring distance and reading topographic maps.

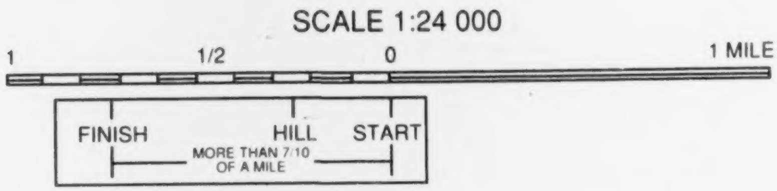
To figure distance, place a slip of paper on the map. Mark the start and the distance to the first corner. In the example below, the first corner is the hill.

With the mark for "hill" on the hill, turn the slip to line up with the route to the next corner. Mark the "End" or "Finish."



Used with permission of the Boy Scouts of America.

To find the distance, place the "Start" line at "O" on the scale and read the distance to the left if less than 1 mile. If the distance is more than 1 mile (or whatever the scale is on the map) move the "Start" to the end of the scale and mark the distance to "0" for each length.



The Distance Is A Little More Than 7/10ths Of A Mile

Used with permission of the Boy Scouts of America.

Distance can also be found by using a string and marking the string with a pen. Mark or tie a knot at the end you start with.

DIRECTIONS

Study the map, legend, and scale on the next page. The route is marked for you. Measure the distance and determine the directions according to the questions below.

You will need: Compass, ruler, scissors, blank paper cut into 2 1/2" x 1/2" strips or string and pen

1. Mark the map for magnetic north.
    a. Find magnetic north using one of these methods:
        (1) Use the scale on the map using declination information from Unit 10 or provided by your instructor; OR
        (2) Line up a compass with North as marked on the map. Find magnetic north and mark it with your ruler
    b. Draw the magnetic north-south line across the map according to the declination for your area.
    c. Draw parallel lines a ruler's width apart on the rest of the map.
2. How is the left end of the scale divided? ________________
3. How many feet between contour lines? ________________

4. The elevation of point 1 is 760 feet. Will you be going uphill or downhill to point 2? ______________________

5. What direction will you go from 2 to 3? ______________

6. How high is the hill between 4 and 5? ______________

7. What is the direction from 5 to 6? ________________

8. What is the approximate distance from 5 to 6? ________

9. What kind of road will you be walking on between 6 and 7?
____

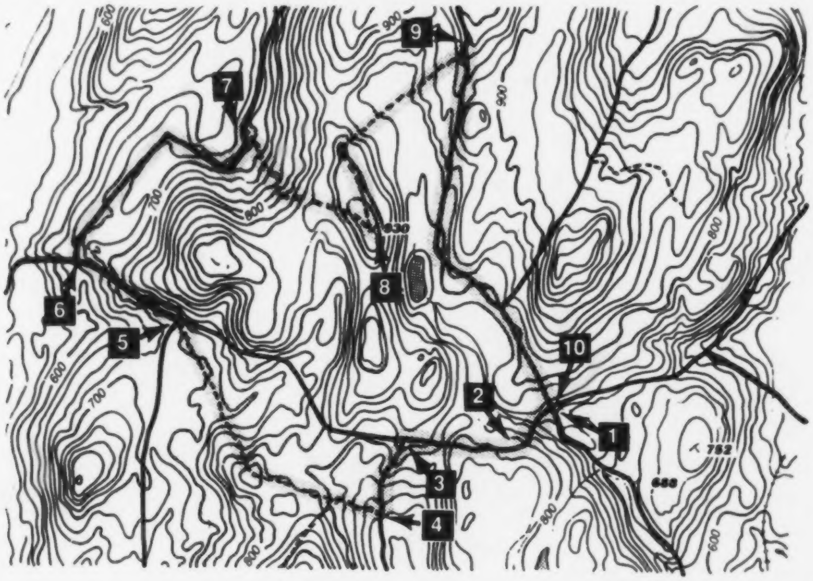
10. What kind of road will you be walking on between 7 and 8?
____

11. What kind of road will you be walking on between 8 and 9?
____

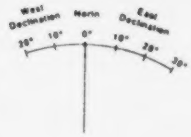
12. How far is it from 9 to 10? ____________________

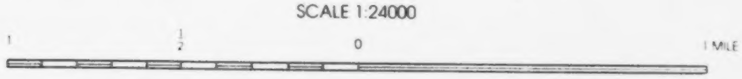
13. What is the total distance? ____________________

14. If walking speed is about 3 miles an hour, how long will it take you to hike from 1 to 10? ______________


9
7
6
5
8
10
2
1
3
4
600
700
800
900
830
752
680

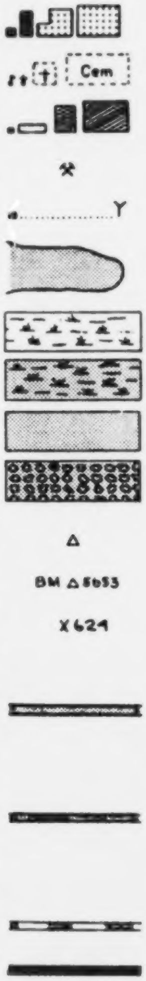
Magnetic Lines.— Draw your magnetic north-south line across this map. See page 209. Then draw other lines a ruler's width apart.


West Declination
North
East Declination
20°
10°
0°
10°
20°
30°

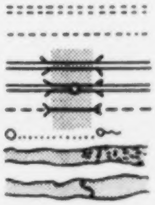

SCALE 1:24000
1
1/2
0
1 MILE

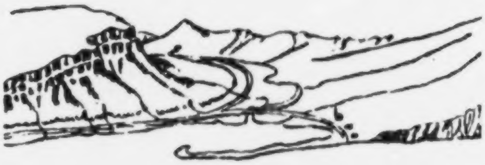
Map Symbols.—Map makers use signs and colors to show what is on the land.

Buildings (dwelling, place of employment, etc.) ....
School—Church—Cemetery .....
Buildings (barn, warehouse, etc.)
Open pit or quarry ....
Shaft—Tunnel entrance ....
Earth dam .....
Marsh or swamp.
Wooded marsh or swamp ....
Woods — Brushwood ....
Orchard ....
Map maker's control marker ...
Monuments showing elevation ..
Simple elevation marker ....
Hard surface roads, heavy duty, four or more lanes wide
Hard surface roads, heavy duty, two or three lanes wide ....
Hard surface roads, medium duty, two or three lanes wide ....
Improved dirt roads ....

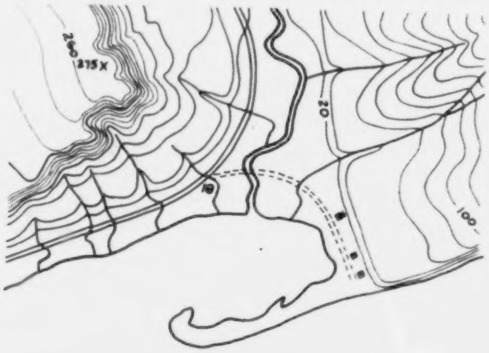


Unimproved dirt roads ....
Trail ....
Bridge, road ....
Drawbridge, road
Footbridge .....
Waterwell-spring
Large rapids ....
Small rapids ....





Topographic Maps.—The best maps for hiking are made by the Government. They show the hills and valleys.



Contour Lines.—Topographic maps give you a pilot's view of the earth. The first contour line is 20 feet. Between each line is another 20 feet. Where the lines are close together, the hill is steep. Where they are far apart, the land is almost flat.

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ASSIGNMENT SHEET 4

USE LEGAL LAND DESCRIPTIONS

XI

NAME ________________________ SCORE ________

OBJECTIVE 13

Identify symbols and features on a United States Geological Survey (USGS) map.

INTRODUCTION

The skills you learn to complete this assignment sheet will enable you to read many types of maps and map symbols. Foresters, wildlife managers, and technicians and professionals in related areas can tell you that the ability to read and use USGS maps is an important skill.

DIRECTIONS

Using the USGS topographical map supplied by your instructor, answer the following questions.

1. What is the magnetic declination on this map in degrees? ________________________
2. What is the contour interval? ________________
3. What is the highest point of elevation in section 14 of the Glencoe township? ________________
4. What types of roads are found in section 11 of the Stillwater township? ________________
5. What is the length of the runway running north and south located at the airport northwest of Stillwater? Answer may be to the nearest one thousand feet. ________________

ASSIGNMENT SHEET 1

1. a. (Example)
   b. T2N, R7E
   c. T3S, R3E
   d. T2S, R4W
   e. T1N, R7W

2.

↑ N

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

3. a. 3
   b. 8
   c. 30
   d. 31
   e. 36

ASSIGNMENT SHEET 2

PART 1

A. NW1/4 NW1/4, Section 10

ACRES: 40

B. S1/2 NE1/4, Section 36

ACRES: 80

C. N1/2 SE1/4, Section 9

ACRES: 80

D. E1/2 NW1/4 NE1/4, Section 2

ACRES: 20

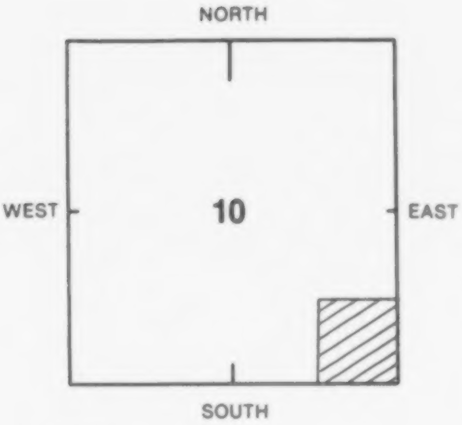
E. SW1/4 AND N1/2 SE 1/4, Section 15

ACRES: 240

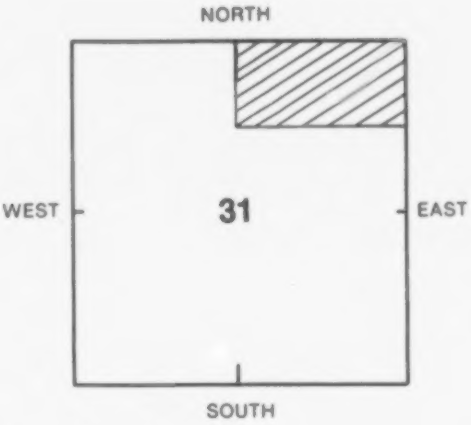
F. N1/2 NE1/4 NE1/4, Section 20

ACRES: 20

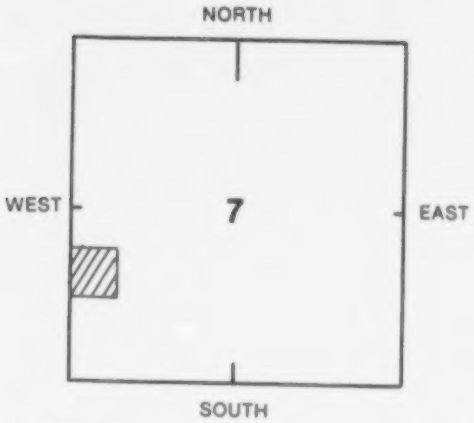
PART 2


NORTH
WEST
10
EAST
SOUTH

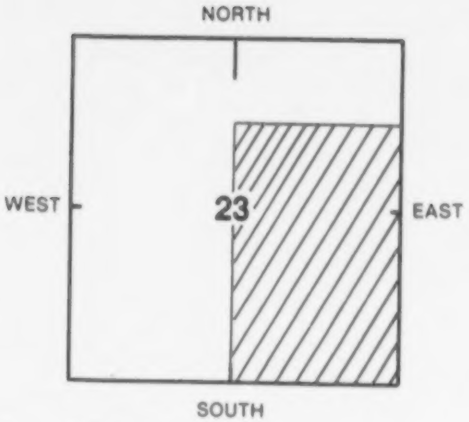
40 acres


NORTH
WEST
31
EAST
SOUTH

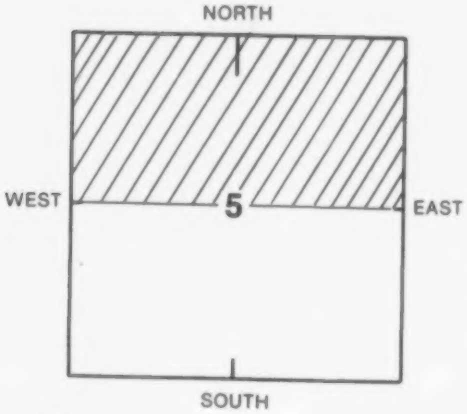
B. 80 acres


NORTH
WEST
7
EAST
SOUTH

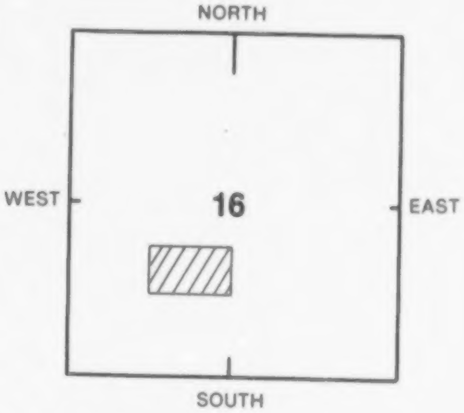
C. 10 acres


NORTH
WEST
23
EAST
SOUTH

D. 240 acres


NORTH
WEST
5
EAST
SOUTH

E. 320 acres


NORTH
WEST
16
EAST
SOUTH

F. 20 acres

ASSIGNMENT SHEET 3

1. Check that magnetic north lines are the correct degrees of declination for your area.
2. 10ths of a mile
3. 20
4. Uphill
5. West
6. 840'
7. NW
8. 3 1/2 tenths of a mile or .35
9. Light-duty
10. Unimproved
11. Trail
12. 1.1 mile
13. 5.0 - 5.3, depending on method used
14. About 1 hour 40 min. (1.66 hr)

ASSIGNMENT SHEET 4

1. 7 1/2°
2. 10 feet
3. 1037 feet
4. Heavy-duty, medium-duty, light-duty. Student may include railroad.
5. 5,000 feet

WRITTEN TEST

USE LEGAL LAND DESCRIPTIONS

XI

NAME ______________________________ SCORE _______

OBJECTIVE 1

Match terms associated with legal land descriptions to their correct definitions. Write the correct letters in the blanks.

____ 1. The vertical distance between the planes of consecutive contour lines, such as 5, 10, 20, 100, or 200 feet or meters.

____ 2. Section of a map that explains the symbols used on that map

____ 3. Permanent object, natural or artificial, that marks established points

____ 4. Every 5th contour line, which indicates the elevation

____ 5. Vertical distance above or below sea level

____ 6. Partial

____ 7. A vertical scribe made with an ax or with paint

____ 8. A horizontal notch made on the side of a tree or rock; or a horizontal line painted on a tree or rock

____ 9. An imaginary line on the ground connecting all points that are the same elevation above or below sea level

____ 10. The average elevation between high and low tide

____ 11. Horizontal angle measured from north or south and referenced to one of the quadrants of the compass

____ 12. A written statement recognized by law as the definite location of a tract of land by reference to a survey, recorded map, adjoining property, or recorded monument

____ 13. A map of a piece of land

a. Bar
b. Bearing
c. Blaze
d. Contour elevation
e. Contour interval
f. Contour line
g. Elevation
h. Fractional
i. Graphic map
j. Geologic map
k. Hack
l. Index contour line
m. Index map
n. Legal land description
o. Legend
p. Marker block
q. Monument
r. Plat
s. Primary contour line
t. Sea level
u. Slash

___14. A line and symbol representation of natural and selected man-made features of a part of the earth's surface plotted to a definite scale; portrays the shape and elevation of the terrain by contour lines

___15. A unit of measurement approximately equal to a man's step

___16. United States Public Land Survey

___17. United States Geological Survey

v. Topographic map

w. Tract map

x. USGS

y. USPLS

z. Vara

OBJECTIVE 2

List reasons for land location in forestry. Write three reasons in the space provided.

____

____

____

____

____

____

OBJECTIVE 3

Distinguish among types of legal land descriptions. Write "US" in the blank before an example or characteristic of the U.S. public land survey system; "L&B" before an example or characteristic of lot and block description; or "M&B" before an example or characteristic of metes and bounds description.

________ 1. System used to describe forested and other irregularly-shaped tracts.

________ 2. A system put in place by the Continental Congress on May 20, 1785 for the survey of all public lands in the United States.

________ 3. Lot 4, Block 11, Forest Acres subdivision, City of Henderson, Jefferson County, State of Tennessee

________ 4. A system of describing land from a starting point on the boundary, listing the compass directions and distances from point to point entirely around the tract.

________ 5. The purpose is to survey land so that in general, and in all cases where practical, the survey units are rectangles.

________ 6. Also called "the sectional system."

________ 7. A system of describing land by referring to a recorded plat, the lot number, the county, and state.

________ 8. N1/2 NW1/4 SW1/4, Section 6, T55N, R69W

OBJECTIVE 4

Match line divisions used in the United States Public Land Survey (USPLS) system to their descriptions. Write the correct letters in the blanks.

____ 1. The longitude, a line running true north and south, that intersects the base line at the initial point

____ 2. Formed by the intersection of the base line and the principal meridian

____ 3. North-south lines at six-mile intervals parallel to the principal meridian

____ 4. East-west lines at six-mile intervals parallel to the base line

____ 5. True meridians extended north from the base line or from standard parallels at intervals of 24 mile east and west from the prinicipal meridian

____ 6. Lines surveyed every 24 miles north and south of the base line and parallel with it

____ 7. The latitude, a principle parallel line running true east and west; it intersects the principal meridians at the initial point

a. Base line

b. Correctional lines

c. Guide meridians

d. Initial point

e. Prime meridian

f. Prime parallel

g. Principal meridian

h. Range lines

i. Section

j. Signal meridians

k. Standard meridians

l. Standard parallels

m. Township lines

OBJECTIVE 5

Choose the best word or phrase to complete statements about subdivisions of the USPLS system. Circle the correct answers.

1. Lot numbers on river lots usually run __________ .
   a. upstream to the section line, then downstream
   b. upstream throughout the section
   c. downstream to the section line, then upstream
   d. downstream throughout the section
2. Townships are divided into __________.
   a. ranges
   b. sections
   c. quadrants
   d. lots
3. The correct township description is __________.
   a. T1N, R2W
   b. R3E, T4W
   c. T2S
   d. R4W
4. In counties bordering oceans, lakes, and streams, you can expect to have __________ .
   a. correction lines
   b. irregular subdivisions
   c. broken meridians
   d. fractional sections
5. A section is approximately __________.
   a. 10 chains
   b. 1 square mile
   c. 4 square miles
   d. 320 acres

6. Quadrangles are divided into __________.
   - a. townships
   - b. ranges
   - c. sections

7. The #1 section in a township is always in the __________.
   - a. northwest corner
   - b. northeast corner
   - c. southwest corner
   - d. southeast corner

8. The length of each side of a township, except the north where the distance is slightly smaller, is __________.
   - a. 1 mile
   - b. 6 miles
   - c. 24 miles

9. The section subdivision that is INCORRECT is __________.
   - a. 5 acres
   - b. 10 acres
   - c. 40 acres
   - d. 80 acres
   - e. 160 acres
   - f. 320 acres

10. Quadrangles are approximately __________.
    - a. 320 square-mile divisions
    - b. 40 square-mile divisions
    - c. 24 square-mile divisions

11. Correction lots or fractional sections are fractional lots of __________.

    a. one-half acres

    b. 5 acres

    c. 10 acres

    d. 40 acres

12. From the principle meridian, ranges are numbered consecutively __________ .

    a. north and south

    b. east and west

    c. northeast and southwest

    d. southeast and northwest

OBJECTIVE 6

Choose the correct word or phrase to complete statements about reading USPLS system subdivision descriptions. Circle the correct word or phrase to complete the statement.

1. It is easier to read legal descriptions from (left to right; right to left)

2. The symbols **and**, **&**, and **; (semicolon)** mean (smaller divisions; separate tracts).

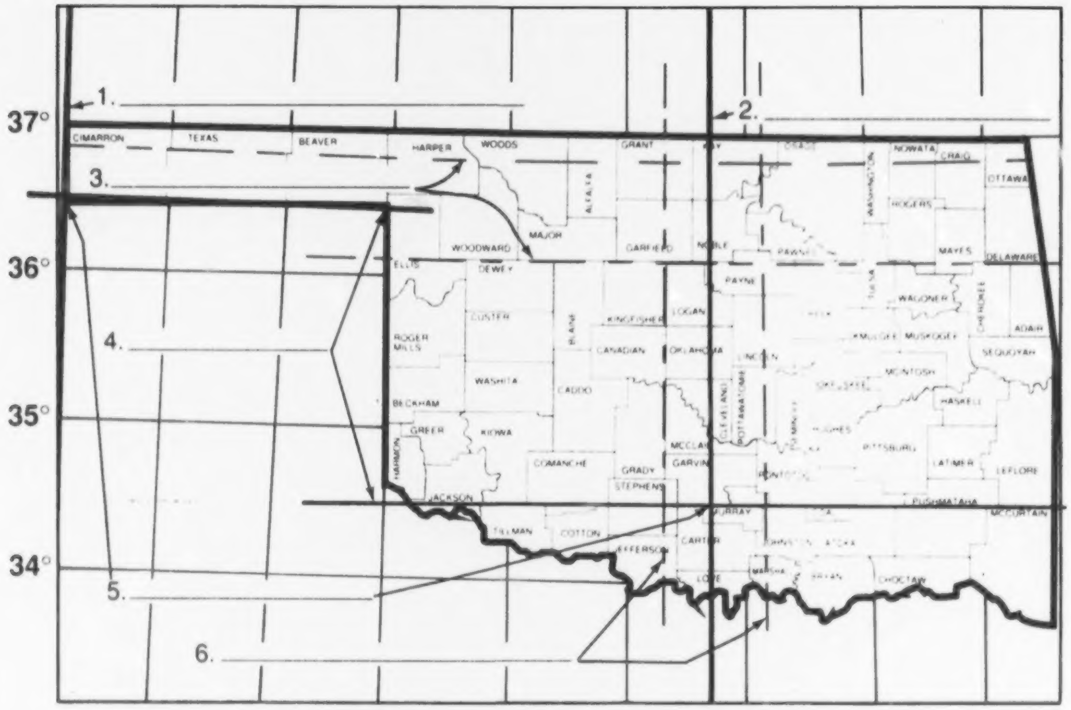
3. A full legal description starts with the (smallest; largest) divisions.

4. Two letters alone means (1/4; 1/2; 1) section.

5. 80 acres make (1/2 of 1/4; 1/4; 1/2) section.

6. A single letter means (1/4; 1/2; 1) section.

OBJECTIVE 7 | **Identify the principal meridians, base lines, and initial points in your state.**


37°
36°
35°
34°
1.
2.
3.
4.
5.
6.
CIMARRON
TEXAS
BEAVER
HARPER
WOODS
ALFALFA
GRANT
KAY
OSAGE
NOWATA
CRAIG
OTTAWA
WASHINGTON
ROGERS
MAJOR
WOODWARD
GARFIELD
NOBLE
PAWNEE
MAYES
DELAWARE
ELLIS
DEWEY
PAYNE
TULSA
WAGONER
CHEROKEE
ADAIR
CUSTER
BLAINE
KINGFISHER
LOGAN
CREEK
OKMULGEE
MUSKOGEE
SEQUOYAH
ROGER MILLS
CANADIAN
OKLAHOMA
LINCOLN
MCINTOSH
WASHITA
CADDO
OKFUSKEE
HASKELL
BECKHAM
CLEVELAND
POTTAWATOMIE
SEMINOLE
HUGHES
GREER
KIOWA
PITTSBURG
LATIMER
LEFLORE
HARMON
COMANCHE
MCCLAIN
GRADY
GARVIN
PONTOTOC
STEPHENS
JACKSON
MURRAY
COAL
PUSHMATAHA
MCCURTAIN
TILLMAN
COTTON
JEFFERSON
CARTER
JOHNSTON
ATOKA
LOVE
MARSHALL
BRYAN
CHOCTAW

OBJECTIVE 8 | **Select from a list information found on a map legend.** Write an "X" in the blank before each correct answer.

____ 1. Highway and road classification symbols

____ 2. Location of bodies of water

____ 3. Magnetic north arrow on topographic maps

____ 4. True north arrow

____ 5. Longitude and latitude

____ 6. Scale showing proportion that distance on the map bears to actual distance

____ 7. Railroad lines

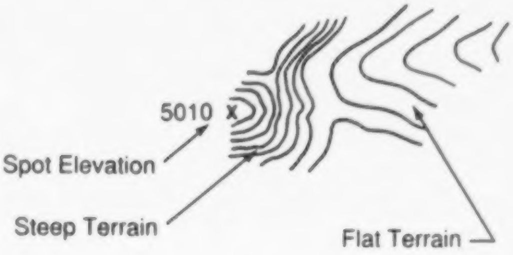
____ 8. List of major cities

____ 9. Scale representing miles to the inch

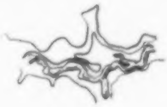
___ 10. Zones

OBJECTIVE 9

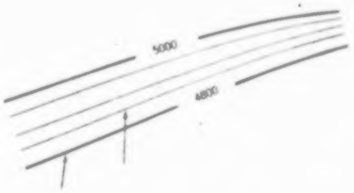
Label contour configurations. Write the correct name of each configuration in the blank.


5010 x
Spot Elevation
Steep Terrain
Flat Terrain

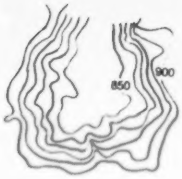
1.______________________________



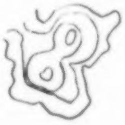
2.______________________________



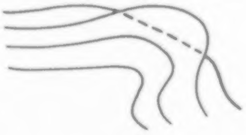
3.______________________________



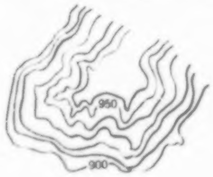
4.____________________________



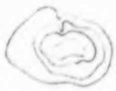
5.____________________________



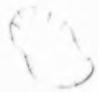
6.____________________________



7.____________________________



8.____________________________



9. ____________________________

NOTICE	The following assignment sheets are not part of the written test. If these activities have not been completed, check with your instructor.	
OBJECTIVE 10	**Identify subdivisions of the USPLS system.**	SCORE ________
OBJECTIVE 11	**Interpret descriptions for the subdivision of a section.**	SCORE ________
OBJECTIVE 12	**Determine distance and direction on a topographic map.**	SCORE ________
OBJECTIVE 13	**Identify symbols and features on a United States Geological Survey (USGS) map.**	SCORE ________

WRITTEN TEST ANSWERS

USE LEGAL LAND DESCRIPTIONS

XI

OBJECTIVE 1

1. e
2. o
3. q
4. l
5. g
6. h
7. c
8. k
9. f
10. t
11. b
12. n
13. r
14. v
15. z
16. y
17. x

OBJECTIVE 2

Answer shoud include:

- Retrace old boundary lines
- Locate property boundaries
- Lay out boundaries for specific uses

OBJECTIVE 3

1. M&B
2. US
3. L&B
4. M&B
5. US
6. US
7. L&B
8. US

OBJECTIVE 4

1. g
2. d
3. h
4. m
5. c
6. l
7. a

OBJECTIVE 5

1. c
2. b
3. a
4. d
5. b
6. a
7. b
8. b
9. a
10. c
11. d
12. b

OBJECTIVE 6

1. right to left
2. separate tracts
3. smallest
4. 1/4
5. 1/2 of 1/4
6. 1/2

OBJECTIVE 7

See Teacher Supplement 1 or map showing the principal meridians, base lines and initial points in your state.

OBJECTIVE 8

1, 3, 4, 6, 9

OBJECTIVE 9

1. Steep and flat terrain
2. Stream
3. Index and intermediate contours
4. Valley
5. Saddle
6. Overhang or cliff
7. Ridge
8. Summit
9. Depression

OBJECTIVE 10 Refer to answers to Assignment Sheet 1.

OBJECTIVE 11 Refer to answers to Assignment Sheet 2.

OBJECTIVE 12 Refer to answers to Assignment Sheet 3.

OBJECTIVE 13 Refer to answers to Assignment Sheet 4.

OBJECTIVE SHEET

CRUISE TIMBER STANDS

XII

INTRODUCTION

Cruising is a forestry activity for all seasons. Foresters design a plan to "sample" forested acreage. They record the number and sizes of timber in small areas and then use mathematical formulas to estimate the volume of timber for the entire tract. Cruising is a job that requires measurement skills, compass and pacing skills, knowledge of tally symbols and lots of practice. A good, experienced estimator can determine the DBH of a tree by looking and can make decisions about land use, profit, and management by "eyeballing" a timber stand. Cruising in good weather is a highly enjoyable part of forestry work and a good estimate is a satisfying accomplishment.

PREREQUISITES

Unit VII: Identify and Use Basic Tools of Forestry
Unit VIII: Use Basic Math for Forestry
Unit IX: Practice Tree Measurement

UNIT OBJECTIVE

After completing this unit, the student should be able to determine the types of cruises, the tools used, the methods for cruising, complete systematic grid layouts for plot and point cruising, and determine volume by cruising. The student will demonstrate these competencies by completing the assignment sheet, job sheets, and written test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with cruising to their correct definitions.
2. List tools and materials used in cruising.
3. Describe reasons for conducting a cruise.
4. State factors that determine cruise intensity.
5. Match types of cruises to their descriptions.
6. Describe the sampling layout.
7. Determine which trees should be tallied in a point sampling.
8. Complete a systematic grid layout for a point sampling cruise. (Assignment Sheet 1)

9. Demonstrate the ability to

   a. Use a prism correctly. (Job Sheet 1)

   b. Determine sawtimber volume by point sampling. (Job Sheet 2)

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CRUISE TIMBER STANDS

PREPARATION

- Obtain materials to supplement unit.

  NOTE: See Suggested Resources.

- Review instructional outline for this unit. Modify time frames to suit class needs and plan activities for each class period.

- Study specific objectives to determine those you will cover in your presentation. Decide which objectives should be taught to which students.

- Determine scope and sequence of objectives that you add. Design and develop support materials, including evaluation techniques, for additional objectives.

- Determine how you will schedule time for students to demonstrate competence in the required procedures.

- Locate areas for cruise job sheets. Make or have students make a plan of the area for use in the assignment sheets.

  NOTE: You may want to have a transparency made of the plan for easy discussion with students.

- Invite a consultant or a cruise team to talk to the class about cruising and to demonstrate the basic measurements and formulas.

- Invite a forester and/or a naturalist to go out with students on an informal practice cruise to point out damage, tree conditions, stand age, and to make projections and estimates about the stand.

  NOTE: Supply guest speakers with specific objectives and other appropriate sections of the unit.

- Arrange time away from school to complete the job sheets and to provide practice sessions in cruising techniques.

DELIVERY

Objectives 1 through 5

- Have students review Unit 9 for tool uses and operation and tally symbols.
- Have students review Unit 7 for uses of tools and basic operations of the tools used in cruising.
- Demonstrate the use of these tools and allow students to handle and practice using them.
- Discuss with students cruising, tools, and measurement.
- Demonstrate the use of a wedge prism.
- Invite a forester to discuss reasons for cruising and the different types of cruises.

Objective 6

- Describe methods of planning a sampling layout.
- Prepare a sketch of the land to be cruised and project it for ease of discussion and to point out the topographical characteristics and drainage.
- Go through the sample procedure for making the systematic grid before students complete the assignment sheet.
- Have students complete Assignment Sheet 1.
- Have students complete Job Sheet 1.

Objective 7

- Take students on an informal field trip to practice cruising skills. Point out interesting observations along the way or invite a forester and/or a naturalist to accompany the class and increase their awareness of forestry conditions.
- Discuss which trees should be tallied in a point sampling.
- Give students an opportunity to practice with a wedge or other point-sampling tool.

APPLICATION

NOTE: Provide an opportunity for students to practice assignment sheet problems and job sheet procedures before their work is evaluated.

Objective 8

- Use Assignment Sheet 1 to help students understand the principles of laying out a cruise plan and to enhance math skills.
- Provide a sample graph of the area to be cruised. Prepare the answers to the assignment sheet to match your design.
- Go over the process with students before having them complete the assignment sheet.
- An extra blank grid sheet is included for a practice exercise.

Objective 9a

- Use Job Sheet 1 to give students practical experience using a wedge prism.

Objective 9b

- Use Job Sheet 2 to give students practical experience determining sawtimber volume by point sampling.

EVALUATION

Practical test

- Explain to students that they will be asked to demonstrate procedures on the job sheets to complete the practical test.
- Describe the rating scale used on the practical test.
- Give practical test.
- Reteach and retest as necessary.

Written test

- Explain to students that they will be asked to demonstrate on the written test actions listed in the specific objectives.
- Give written test.

  NOTE: The written test may be given in sections if desired.
- Evaluate students on assignment sheet activities if not previously done.
- Reteach and retest if necessary.
- Complete appropriate section of competency profiles.
- Review individual and group performance in order to evaluate teaching methods. Adjust scope, sequence, or instructional approaches for additional lessons as required.

SUGGESTED RESOURCES

Audiovisula Materials

- *Timber Cruising*, Slide/script presentation, 70 slides covering an introduction and definition of board footage and timber cruising concept; using the cruising stick, cruising unusual and imperfect trees, boundary tree consideration, harvesting consideration, timber cruising courses for forestry lab, and calculations and tally of board footage and stumpage.

  NOTE: The above slide set is available to Oklahoma teachers on a free loan basis. Oklahoma teachers may order from the Oklahoma Department of Vocational and Technical Education, Resource Center, ATTN: Instructional Media Specialist, 1500 West Seventh Avenue, Stillwater, OK 74074.

Speakers

- Oklahoma Natural Resources Speakers Bureau sponsored through Oklahoma State University, Division of Agriculture, Oklahoma Cooperative Extension Service - Forestry, Oklahoma Conservation Commission and the Oklahoma Forestry Association. Lists speakers on a variety of forestry-related topics. Speakers operate on a time-available basis. Request a listing of speakers, programs, slide presentations and videotapes from your local extension office or from:

Dr. Steve Anderson
Forestry Dept.
Oklahoma State University
239 Agricultural Hall
Stillwater, OK 74078
(405) 744-9431

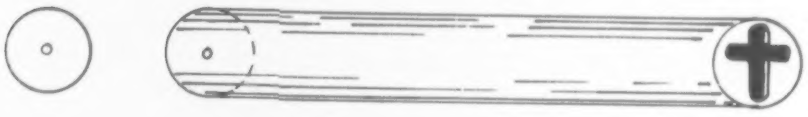
Dave Marcouiller
Forestry Dept.
Oklahoma State University
242 Agricultural Hall
Stillwater, OK 74078
(405) 744-5444

Teachers from outside of Oklahoma should contact the Forestry Extension Office in their state.

OBJECTIVE 1

Match terms associated with cruising to their correct definitions.

- **Angle gauge**—An instrument with a fixed angle the size needed for a particular BAF



Angle Gauge

- **Basal area (BA)**—The area of a cross section of tree at stump height; expressed in square feet

  NOTE: BA can apply to individual trees or to all trees on an acre basis.

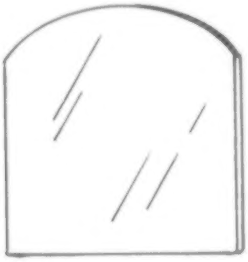
- **Basal area factor (BAF)**—The numerical value of the prism or other angle gauge instrument that gives the basal area per acre for each tally tree
- **Borderline trees**—Trees just on the boundary of the plot sample area
- **Cruise intensity**—The percent of area actually occupied and measured as a sample; expressed as a percent of area
- **Cruising**—Estimating the volume of standing timber
- **Expansion factor**—A numerical value used to convert the volume of acres in a sample to the volume of acres in the total tract
- **Fixed-radius plot**—A section of land with a convenient radius to make the math easier

  EXAMPLES: The cruise measures plots of 1/4 acre or 1/5 acre, etc.

- **Interval**—The distance between plots or points
- **Point**—The reference point from which a point sample is taken

- **Uniform stand**—An area in which the trees are roughly the same size and species
- **Wedge prism**—A wedge-shaped rectangular glass that causes a distortion of light, displacing the image toward the thinner edge; used to estimate the basal area of a stand

  NOTE: The wedge prism is the most common method of sampling. The glass is ground to bend light rays to a specific angle for a particular BAF. The most common prisms are 10 and 20 BAF. BAF sizes range from 1 1/2 to 100 and prisms are also available in metric BAF.



Wedge Prism

OBJECTIVE 2

List tools and materials used in cruising.

- Diameter tape
- Compass
- Steel tape
- Increment borer
- Hypsometer (Biltmore stick or Abney Hand Level)
- Wedge prism or basal area angle gauge
- Clinometer (or Abney Hand Level)
- Map and/or grid layout
- Tally sheet
- Clipboard and pencils

OBJECTIVE 3

Describe reasons for conducting a cruise.

Before the cruise, the estimator prepares a plot layout of the area, including the points where the samples will be taken, and also obtains maps and studies information about the area from the county *Soil Survey.*

On a cruise, an estimator and usually a compass or tally person walk through a stand of trees and measure samples of timber. By taking measurements in several small areas, foresters can gather data about the whole stand. The type of cruise used depends on the type and amount of information needed.

A cruise is an inventory of the quantity and quality of standing timber and the ground conditions. A typical cruise might include the number of trees in the area, the tree diameters, tree heights, species, density of growth, soil conditions, topographic features, etc.

The reasons for conducting a cruise are:

- To make land and timber appraisals, determine size, estimate values, and project desirable uses
- To make estimates and set contracts for timber sales
- To plan management strategies

  EXAMPLE: Which trees should be cut and when; which should be left for different uses, such as pulpwood or sawtimber, forage for wildlife or livestock, etc.

- For special surveys

  EXAMPLE: To determine needs for timber stand improvement (TSI), planting areas, insect and disease damage, timber trespass, blown-down timber, etc.

OBJECTIVE 4

State factors that determine cruise intensity.

Generally, higher-intensity cruises are used for higher-valued timber. Small tracts require a more intensive cruise because a higher error rate is more likely in a smaller area.

- Timber values
- Total land area

  NOTE: The intensity, or extent, of the cruise is determined largely by the timber values and the total land area.

- Allowable costs
- Topography of the tract
- Uniformity of the stand
- Number of species
- Desired precision or accuracy of the estimate

OBJECTIVE 5

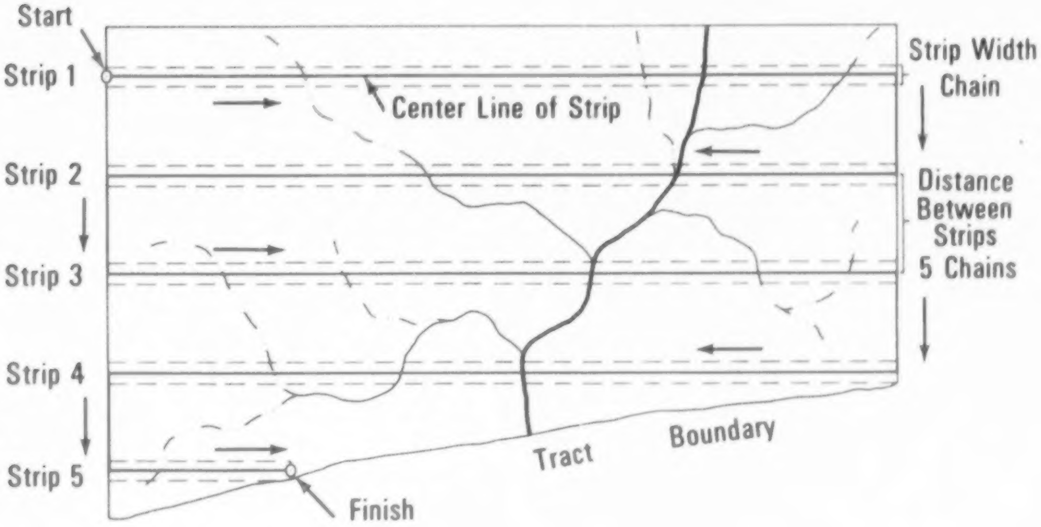
Match types of cruises to their descriptions.

- **100 percent** or **total cruise**—All trees in a stand are measured; the cumulative volume of each tree is the volume measure for the stand as a whole. The total cruise is the most accurate method, but too expensive to be used on large timber tracts.

- **Partial cruise**—Measures a percentage sample of the total area in strips or plots at regular intervals.

- **Strip cruise**—Measures all trees inside a strip of specific width, usually 66 ft or 1 chain. One acre is measured for each 10 chains (660 ft) of strip.

  NOTE: The intensity of cruise depends on the distance between center lines in the strips. If a strip is 66 ft (1 ch), the cruise is 100%; if the strip is 132 ft (2 ch), the cruise is 50%; if the distance is 264 ft (4 ch), the cruise is 25%.


Start
Strip 1
Center Line of Strip
Strip Width
Chain
Strip 2
Distance
Between
Strips
5 Chains
Strip 3
Strip 4
Strip 5
Finish
Tract
Boundary

Strip Cruise Design

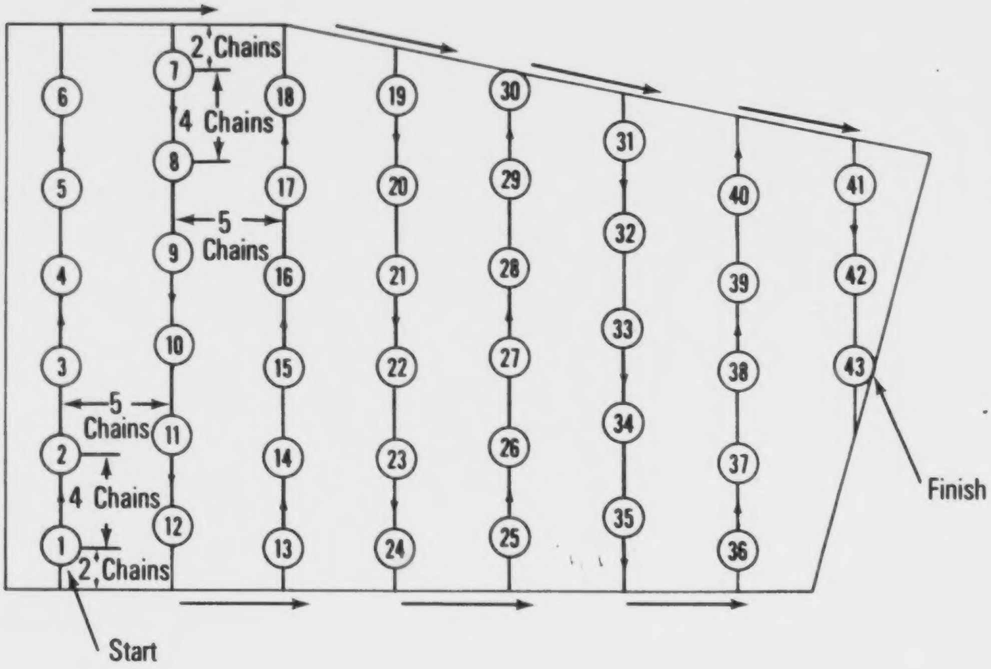
- **Plot cruise**—Measures all timber on evenly-distributed circular plots, 1 acre, 1/4, 1/5, or 1/10 acre to total about 1/4 or 1/5 of the total land area, and considered as a fair sampling of the whole tract.

  Plot intensity is determined by:

  $$\frac{\text{Plot size in acres X number of plots established}}{\text{Number of acres in the tract}} \text{ X } 100$$

  EXAMPLE: On a 1/5 acre cruise of a 40-acre tract, with 20 plots:

  $$\frac{1/5 \text{ X } 20}{40} = \frac{4}{40} = .10 \text{ X } 100 = 10\%$$


2 Chains
4 Chains
5 Chains
5 Chains
4 Chains
2 Chains
Start
Finish
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
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42
43

Plot Cruise Layout

The strips, or passes, are 5 chains apart and the plots are 4 chains apart, with 2 on each end to create an even distance equal to 1/2 the distance between plots.

EXAMPLES: If a stand is 100 acres and the cruise is 100 samples of 1/5 acre, then 20 acres is sampled in a 1/5 (20%) cruise.

If a stand contains 40 acres and 40 1/4-acre plots are sampled, then 10 acres, or 25%, of the total land has been measured.

The amount of timber found on these plots is multiplied by 5 in the first example and by 4 in the second example to get an estimate of the total stand volumes.

- **Average tree cruise**—Used to make rough estimates in uniform stands of smaller sizes. After inspecting the trees, the forester selects a tree of average height, diameter, and quality to represent the whole stand. All the trees are counted and the volume determined by multiplying the number by the value of the average tree.

  This method involves an error rate of 15% or more and is used only when accuracy is not important and a rough estimate will suffice.

- **Eyeball** or **Ocular cruise**—Used primarily for planning more comprehensive cruises and for low-accuracy estimates. An experienced cruiser can judge timber quality, size, amount, etc., by "eyeballing it," driving by or walking through a stand in no particular pattern.

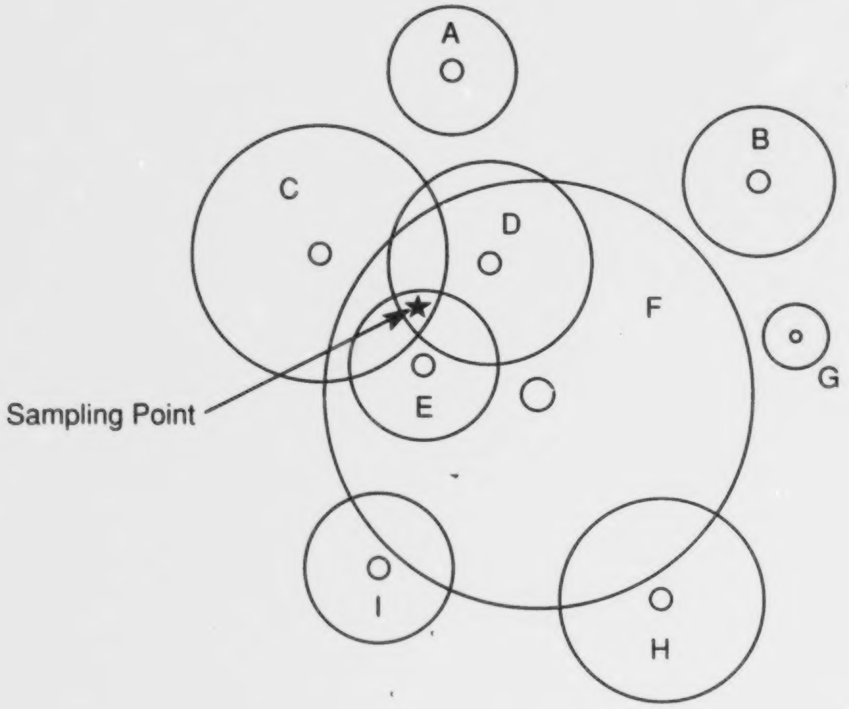
  This method has a low accuracy rate, and may involve an error rate of up to 25%.

- **Point sampling**—A fixed-angle measuring instrument, such as a wedge prism, is used to take a sample of trees based on size only, and not on the number of trees in an area. Tree volume is determined by finding the basal area per acre.

  Trees are "in," meaning to be counted or tallied; or "out" if they are too small to be tallied.

  Each diameter size has its own plot radius and the radius varies directly with the tree diameter. Therefore, the largest and most valuable trunks are usually sampled more intensively than the smaller trunks.

The plot radius is determined by the plot radius factor (PRF). The PRF is a numerical value that when multiplied by the DBH gives the distance in feet that the tree can be within and be tallied. See Supplement 3.



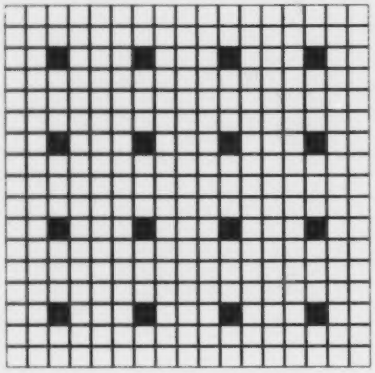
Point Sampling

NOTE: Trees C, D, E, and F are "in." The plot radius must enclose the sample point for the tree to be tallied.

OBJECTIVE 6

Describe the sampling layout.

- The cruise is planned ahead of time to guarantee that the sample is large enough and is representative of the whole tract.
- A layout is the plan or design of the cruise and can serve as a kind of map during the sampling.
- In the grid sample, the plots to be sampled are equidistant over the tract.



Systematic Grid Sample

OBJECTIVE 7

Determine which trees should be tallied in a point sampling.

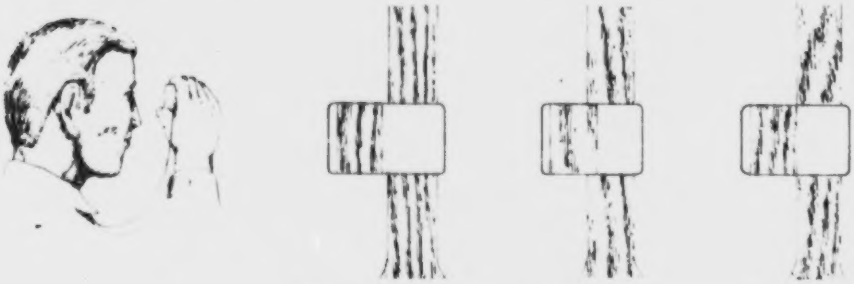
The wedge prism is the most common tool for point sampling. It is accurate enough for the job and relatively inexpensive. The Relaskop is an expensive tool, but is accurate for taking a variety of tree measurements. Other tools include the angle gauge, Cruiser's Crutch and the Cruz All. These can measure 10, 20, 30, and 40 BAF.

These tools indicate whether a tree has a DBH large enough to be tallied by showing the tree to be "in" or "out."

- **Wedge prism**

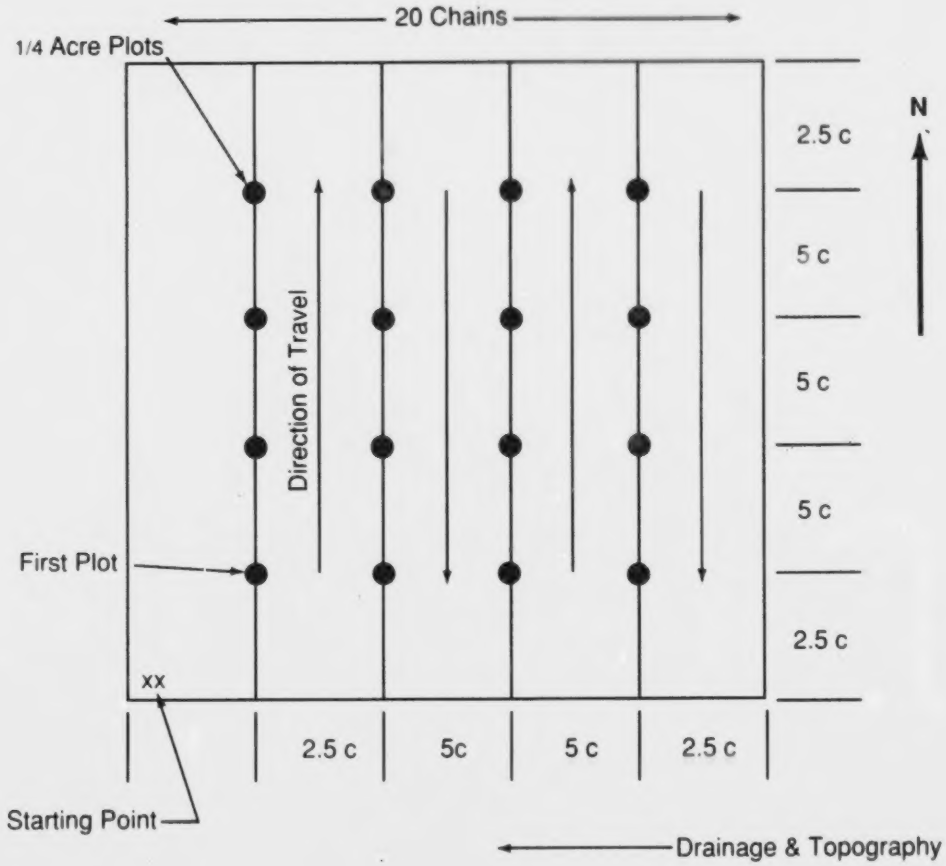
The prism is held directly over the sampling point at a comfortable length from the eye, at a right angle to the line of sight. Slope corrections have to be made if the slope is greater than 15%, a 15-foot drop or rise in 100 ft of horizontal distance. Trees are counted when the prism offsets a portion, but not all, of the tree stem. If the prism shows an alignment of the stem and the offset, the tree is considered *borderline*.

- How to count borderline trees—Whether a borderline tree is counted depends on the purpose of the cruise and the value of the timber. Where a high degree of accuracy is required, the forester will measure the tree to determine whether it is in or out. A standard practice is to count every other borderline tree.


Offset Complete Don't Count This Tree
Partial Offset Do Count This Tree
Borderline Count every other tree

Prism Offsets a Portion of the Tree Stem

SYSTEMATIC GRID FOR A 10% CRUISE ON A 40-ACRE TRACT USING 1/4 ACRE PLOTS


20 Chains
1/4 Acre Plots
N
2.5 c
5 c
5 c
5 c
2.5 c
Direction of Travel
First Plot
xx
Starting Point
2.5 c
5c
5 c
2.5 c
Drainage & Topography

COMMON PLOT DIMENSIONS

Circular Plot

Plot (acres)	Radius in Feet	Radius in Chains	Rods
1/160	9.31	0.141	0.564
1/40	18.62	.282	1.13
1/10	37.24	.564	2.26
1/5	52.66	.789	3.19
1/4	58.88	.892	3.57
1/2	83.26	1.262	5.05
1	117.75	1.784	7.14

Square Plot

Plot (acres)	Side of square in Feet	Side of square in Chains	Rods
1/160	16.5	0.25	1.0
1/40	33.0	0.5	2.0
1/10	66.0	1.0	4.0
1/5	93.34	1.414	5.66
1/4	104.35	1.581	6.32
1/2	147.57	2.236	8.94
1	208.71	3.162	12.65

Rectangular Plot (Intermittent Strips)

Plot area (acres)	Length (chains)	Width (chains)
1/20	2.0	0.25
1/10	2.0	0.5
1/5	2.0	1.0
1/5	4.0	0.5
1/4	2.5	1.0
1/4	5.0	0.5
1/2	5.0	1.0

BASAL AREA FACTORS AND PLOT RADIUS FACTORS

PRFs for commonly used BAFs

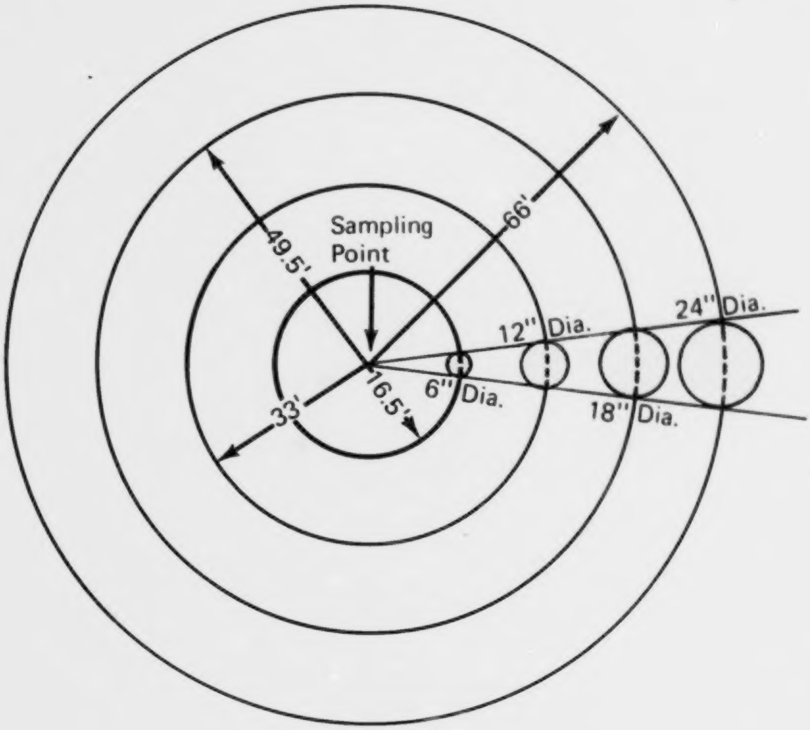
The PRF is a numerical value that when multiplied by the DBH gives the distance in feet that the tree can be within and be tallied.

(PRF X DBH = DISTANCE)

BAF	PRF (ft)
5	3.889
10	2.750
20	1.944
40	1.375

Formula for plot radius factor

PRF X DBH = Distance in feet the tree can be within and be tallied


Sampling Point
49.5'
66'
33'
16.5'
6" Dia.
12" Dia.
18" Dia.
24" Dia.

BASAL AREA OF TREES BY DBH CLASSES

DBH (in.)	Basal Area	DBH (in.)	Basal Area
2	0.022	14	1.069
4	0.087	16	1.396
6	0.196	18	1.767
8	0.349	20	2.181
10	0.545	22	2.640
12	0.785	24	3.142

CRUISE TIMBER STANDS

NAME ______________________________ SCORE ________

OBJECTIVE 8

Complete a systematic grid layout for a point sampling cruise.

INTRODUCTION

Point sampling is the preferred method of cruising because it is faster and easier than plot cruising. Rather than counting each tree in a sample area and then blowing up the number to estimate for the whole tract, the sample is based on tree size. Using the BAF formula, foresters can estimate the total volume or tonnage for the entire tract.

Point sampling may be done on a systematic grid as discussed in Objective 6. The type of cruise depends on the size of the tract, the information desired, and the amount of money allocated for the cruise.

Use the sample grid in Objective 6 in the Information Sheet and in Supplement 1 to help you understand laying out a systematic grid point cruise.

Follow these steps to complete a systematic point cruise layout:

1. Determine the total tract area.
2. Determine the number of points for the total cruise.
3. Determine the number of acres each point represents (representative acres).
4. Determine grid pattern and grid intervals based on the square chains in the acres of Step 3 or by finding a rectangle grid pattern of whole chains as close as possible to a square shape.
5. Locate points in the diagram.
6. Run cruise lines across drainage and topography.
7. a. Locate the first line one-half the interval distance.
   b. Locate the first point one-half the interval distance.

8. Locate the starting point.

EXAMPLE:

1. Tract, 40 acres.
2. Number of points, 15.
3. Representative acres = 40 ÷ 15 = 2.66 acres.

a. Representative square chains = 2.66 x 10 = 26.6 square chains.

b. Square root of representative square chains $\sqrt{26.6}$ = 5.15 chains.

Grid pattern is 5.15 chains by 5.15 chains.

c. Starting point, lines and plot locations as marked on Supplement 1.

DIRECTIONS

Your instructor will describe a tract of land to be used for the cruise. Design a grid plan for a point sampling on a 40-acre tract. Use 20 points for the total cruise or as instructed by your teacher.

1. Determine the number of acres each point represents (representative acres).

representative acres per point ______________

2. Convert the representative acres to square chains.

______________ ch^2

3. Obtain the square root in chains for the representative square chains or for the appropriate rectangle grid.

4. Locate points in the diagram.

5. Run cruise lines across drainage and topography.

6. a. Locate the first line one-half the interval distance.
   b. Locate the first point one-half the interval distance.
7. Locate the starting point.

ASSIGNMENT SHEET 1

Questions and answers may be changed to suit the tract of land to be cruised.

1. 2 acres   40 ÷ 20 = 2 acres
2. $20\ ch^2$ $10 \times 2 = 20\ ch^2$
3. 4.47 x 4.47 ch $\sqrt{20} = 4.47$

CRUISE TIMBER STANDS

OBJECTIVE 9a

Use a prism correctly.

TOOLS AND MATERIALS

- Wedge prism
- Tally sheet or tally person
- Flagging

PROCEDURE

NOTE: These procedures should be performed in a relatively open area, in a dense area, and on leaning trees.

1. Tie a flag on the first tree to be measured.
2. Hold prism with the right hand by the lower part of the thicker edge.

3. Place the prism (not your body) over the selected point at a comfortable distance from the eye, with the curved side upward.

4. Hold the prism at a right angle to the eye, horizontally and vertically (except when measuring leaning trees and when correcting for slopes.)

   NOTE: Tilting the prism away from or toward you can cause a larger displacement and can cause a tree to be left out of the count. Any rotation of the prism in the vertical position will cause a smaller displacement and trees that should be left out are counted.

5. Line up the prism with the tree to be sampled.

   NOTE: The prism must be held over the center of the plot.

6. Determine whether the tree is to be tallied.

7. Record the tree on the tally sheet or report "in" or "out" to the tally person.

   NOTE: In a point sampling, the DBH will be measured or estimated and recorded on the tally sheet.

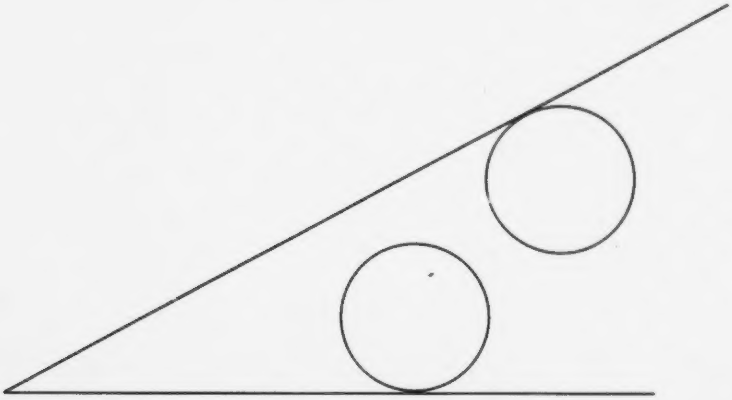
8. Keep the prism in the same place and walk around it in a clockwise direction to the next tree. Be sure not to count the same tree twice.

   a. Walk around the prism. Don't stand in one place and move the prism around you.

   b. If there is an object between you and the tree to be checked, move one step sideways, keeping a constant distance between you and the tree.

c. In dense stands be careful not to confuse or incorrectly associate the trunks.

NOTE: In a dense stand the eye can be easily confused. Light and shadow can also make it difficult to distinguish one trunk from another, especially when a larger tree is behind a smaller tree. To check the accuracy, count the number of trees and match the score with the prism count.



Confusing Two Trees For One

Procedure for leaning trees

Rotate the prism horizontally to the same angle as the tree is leaning.

NOTE: The prism should be at a 90° angle to the tree.

Procedure for borderline trees

Measure the distance to the tree and apply the PRF.

NOTE: In a low-value stand, every other borderline tree could be counted.

JOB SHEET 2 — CRUISE TIMBER STANDS — XII

OBJECTIVE 9b

Determine sawtimber volume by point sampling.

INTRODUCTION

Remember that each diameter size has its own plot radius, and that the radius varies directly with the tree diameter. Therefore, the largest trees are sampled more intensively than the smaller trunks.

The prism estimates the basal area of stands. Practice as much as you can.

TOOLS AND MATERIALS

- Compass
- BAF 10 prism
- Flagging
- Diameter tape
- 50′ or 100′ tape
- Clipboard and pencil
- Tally sheet

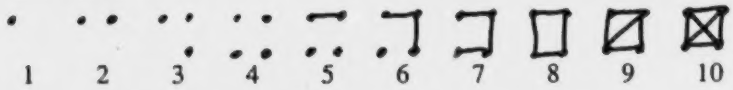
PROCEDURE

1. Locate the first point according to the layout developed in Assignment Sheet 1.
2. Flag the first tree measured.
3. Work in a clockwise direction from the north, using the prism to determine "in" and "out" trees that can be seen from the point.

   NOTE: Remember that the prism must be in the center of the plot. Walk around the prism; do not stand in one place and move the prism around you.
4. Tally all sawtimber: Count trees 9.0" DBH and larger with no less than 7.0" DOB at the top of tree.

   NOTE: Apply the rules for U.S. Forest Service's merchantable heights.
5. Estimate DBH and heights and measure every other tree to develop skill in estimating.

6. Write down tallied trees on the tally sheet provided using dots and dashes.



7. For borderline trees, multiply the trees' DBH times 2.75 to find the maximum distance in feet for the tree to be tallied.

8. When all points have been tallied, add the total trees found in each log height class.

9. Find the volume for the tract using the volume table for point sampling below.

Merchantable Ht. (logs)	Volume Factor
1	4
1 1/2	6
2	8
2 1/2	10
3	12
3 1/2	13.5
4	15
4 1/2	18
5	21

10. Multiply the number of trees tallied in each log height class by the appropriate factor.

11. Add the products obtained in Step 10 and apply to this formula:

$$\text{Volume per acre} = 100 \times \frac{\text{Sum of products}}{\text{Number of points taken}}$$

40 acre tract sawtimber volume = __________ bd ft

12. Have your instructor check your work.

13. Remove flagging and put away tools and materials.

POINT SAMPLE TALLY SHEET

Date ______________________ CREW # ______________________

Pulpwood-H.T. (ft.)

Diameter	10	15	20	25	30	35	40		Point No.	Tally Count	Point No.	Tally Count
3.6 - 4.5 4												
4.6 - 5.5 5												
5.6 - 6.5 6												
6.6 - 7.5 7												
7.6 - 8.5 8												
8.6 - 9.0 9												

Sawtimber 16 ft. Logs

Diameter	1	1 1/2	2	2 1/2	3	3 1/2	4		Point No.	Tally Count	Point No.	Tally Count
9.1 - 10.9 10												
11.0 - 12.9 12												
13.0 - 14.9 14												
15.0 - 16.9 16												
17.0 - 18.9 18												
19.0 - 20.9 20												
21.0 - 22.9 22												
23.0 - 24.9 24												
25.0 - 26.9 26												
27.0 - 28.9 28												
29.0 - 30.9 30												
Write-in												

JOB SHEET 1

Use a prism correctly.

Student's name ____________________ Date __________

Evaluator's name ____________________ Attempt no. _____

Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

Evaluator note: Write a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.

The student:	YES	NO
1. Tied a flag on the first tree to be measured.	_____	_____
2. Held prism with the right hand by the lower part of the thicker edge.	_____	_____
3. Placed the prism (not the body) over the selected point at a comfortable distance from the eye, with the curved side upward.	_____	_____
4. Held the prism at a right angle to the eye, horizontally and vertically.	_____	_____
5. Lined up the prism with the tree to be sampled.	_____	_____
6. Determined whether the tree was to be tallied.	_____	_____
7. Recorded the tree on the tally sheet or reported "in" or "out" to the tally person.	_____	_____

The student:	YES	NO
8. Kept the prism in the same place and walked around it in a clockwise direction to the next tree.	____	____
a. Walked around the prism (did not stand in one place, moving the prism around the body).	____	____
b. If there was an object between the student and the tree to be checked, moved one step sideways, keeping a constant distance between self and the tree.	____	____
c. In dense stands did not confuse or incorrectly associate the trunks.	____	____
Procedure for leaning trees		
Rotated the prism horizontally to the same angle as the tree was leaning, keeping the prism at a 90° angle to the tree.	____	____
Procedure for borderline trees		
Measured the distance to the tree and applied the PRF (or tallied every other tree, if so instructed).	____	____

The student:	YES	NO
9. Used proper tools correctly.	____	____
10. Performed steps in a timely manner.	____	____
11. Practiced safety rules throughout procedure.	____	____
12. Provided satisfactory responses to questions asked.	____	____
13. Put away tools.	____	____

EVALUATOR'S COMMENTS

____

____

____

____

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See performance evaluation key.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:

	4	3	2	1
Determination of trees to be tallied	accurate within 1%	accurate within 2%	accurate within 3%	exceeds 3%
	4	3	2	1
Use of prism on leaning trees	accurate within 1%	accurate within 2%	accurate within 3%	exceeds 3%
	4	3	2	1
Measurement of borderline trees	accurate within 1%	accurate within 2%	accurate within 3%	exceeds 3%

EVALUATOR'S COMMENTS

____

____

____

AVERAGE RATING

Evaluator note: To obtain an average rating for the competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

PERFORMANCE EVALUATION KEY

4 – Skilled—Can perform job with no additional training

3 – Moderately skilled—Has performed job during training program, limited additional training may be required

2 – Limited skill—Has performed job during training program; additional training is required to develop skill

1 – Unskilled—Is familiar with process, but is unable to perform job

JOB SHEET 2

Determine sawtimber volume by point sampling.

Student's name ______________________ Date __________

Evaluator's name ______________________ Attempt no. _____

Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

Evaluator note: Write a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.

The student:	YES	NO
1. Located first point according to the layout developed in Assignment Sheet 1.	_____	_____
2. Flagged the first tree measured.	_____	_____
3. In a clockwise direction from the north, observed all trees of sawtimber size that can be seen from the point.	_____	_____
4. Counted trees 9.0" DBH and larger with no less than 7.0" DOB at the top of tree.	_____	_____
5. Estimated DBH and heights and measured every other tree to develop skill in estimating.	_____	_____
6. Wrote down tallied trees on the tally sheet provided.	_____	_____
7. For borderline trees, multiplied the trees' DBH times 2.75 to find the maximum distance in feet for the tree to be tallied.	_____	_____
8. When all points had been tallied, added the total trees found in each log height class.	_____	_____
9. Found the volume for the tract using the volume table for point sampling.	_____	_____
10. Multiplied the number of trees tallied in each log height class by the appropriate factor.	_____	_____

The student:	YES	NO
11. Added the products obtained in Step 10 and applied formula.	____	____
12. Determined 40 acre tract sawtimber volume.	____	____
13. Used proper tools correctly.	____	____
14. Performed steps in a timely manner.	____	____
15. Practiced safety rules throughout procedure.	____	____
16. Provided satisfactory responses to questions asked.	____	____
17. Removed flagging, put away tools and cleaned work area.	____	____

EVALUATOR'S COMMENTS

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See performance evaluation key.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:				
Point sampling	4 accurate within 2%	3 accurate within 3%	2 accurate within 4%	1 exceeds 4%
Determination of total tract volume	4 accurate within 2%	3 accurate within 3%	2 accurate within 4%	1 exceeds 4%
Tally sheet	4 accurate within 2%	3 accurate within 3%	2 accurate within 4%	1 exceeds 4%

EVALUATOR'S COMMENTS

AVERAGE RATING

Evaluator note: To obtain an average rating for the competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

PERFORMANCE EVALUATION KEY

4 – Skilled—Can perform job with no additional training

3 – Moderately skilled—Has performed job during training program, limited additional training may be required

2 – Limited skill—Has performed job during training program; additional training is required to develop skill

1 – Unskilled—Is familiar with process, but is unable to perform job

WRITTEN TEST

CRUISE TIMBER STANDS

XII

NAME ______________________________ SCORE _______

OBJECTIVE 1

Match terms associated with cruising to their correct definitions. Write the correct letters in the blanks.

____ 1. A section of land with a convenient radius to make the math easier

____ 2. The area of a cross section of a tree at stump height; expressed in square feet

____ 3. Estimating the volume of standing timber

____ 4. A numerical value used to convert the volume of acres in a sample to the volume of acres in the total tract

____ 5. Trees just on the boundary of the plot sample area

____ 6. The numerical value of the prism or other angle gauge instrument that gives the basal area per acre for each tally tree

____ 7. A wedge-shaped rectangular glass that causes a distortion of light, displacing the image toward the thinner edge; used to estimate the basal area of a stand

____ 8. The percent of area actually occupied and measured as a sample; expressed as a percent of area

____ 9. An area in which the trees are roughly the same size and species

___ 10. The reference point from which a point sample is taken

___ 11. The distance between plots or points

a. Angle gauge

b. Basal area (BA)

c. Basal area factor (BAF)

d. Borderline trees

e. Cruise type

f. Cruise intensity

g. Cruise size

h. Cruising

i. Even-age stand

j. Expansion factor

k. Fixed-radius plot

l. Interval

m. Plot radius factor (PRF)

n. Plot diameter factor (PDF)

o. Point

p. Pointing

q. Uniform stand

r. Wedge factor

s. Wedge prism

OBJECTIVE 2

List tools and materials used in cruising. Write six tools and materials.

OBJECTIVE 3

Describe reasons for conducting a cruise. Include three reasons for cruising.

OBJECTIVE 4

State factors that determine cruise intensity. Write five factors.

OBJECTIVE 5

Match types of cruises to their descriptions. Write the correct letters in the blanks.

____ 1. Measures all trees inside a strip of specific width, usually 66 ft or 1 chain. One acre is measured for each 10 chains (660 ft) of strip.

____ 2. Measures a percentage sample of the total area in strips or plots at regular intervals.

____ 3. A fixed-angle measuring instrument, such as a wedge prism, is used to take a sample of trees based on size only, and not on the number of trees in an area.

____ 4. Used to make rough estimates in uniform stands of smaller sizes. After inspecting the trees, the forester selects a tree of average height, diameter, and quality to represent the whole stand.

____ 5. Used primarily for planning more comprehensive cruises and for low-accuracy estimates.

____ 6. Measures all timber on evenly-distributed circular plots, 1 acre, 1/4, 1/5, or 1/10 acre to total about 1/4 or 1/5 of the total land area, and considered as a fair sampling of the whole tract.

____ 7. All trees in a stand are measured; the cumulative volume of each tree is the volume measure for the stand as a whole.

a. Strip cruise
b. Plot cruise
c. Circular cruise
d. Partial cruise
e. 50 percent cruise
f. Eyeball or Ocular cruise
g. 100 percent or total cruise
h. Sample cruise
i. Average tree cruise
j. Point sampling

OBJECTIVE 6

Describe the sampling layout.

Include why the layout is used for cruising.

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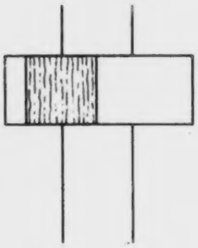
OBJECTIVE 7 **Determine which trees should be tallied in a point sampling.** Write the letters of the trees to be tallied on line 1, of borderline trees on line 2, and answer question 3.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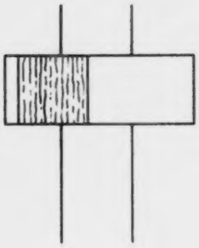
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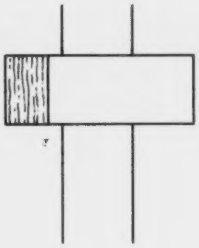
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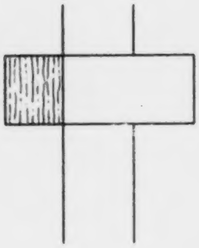
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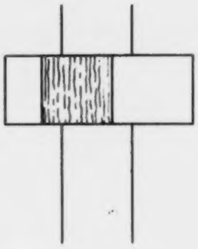

e.

1. Tally ____________________
2. Borderline ____________________
3. How are borderline trees tallied? ____________________

____

____

____

____

NOTICE The following assignment sheets and job sheet are not part of the written test. If these activities have not been completed, check with your instructor.

OBJECTIVE 8 **Complete a systematic grid layout for a point sampling cruise.** SCORE ________

OBJECTIVE 9 **Demonstrate the ability to**

a. Use a prism correctly. RATING ______

b. Determine sawtimber volume by point sampling. RATING ______

CRUISE TIMBER STANDS

OBJECTIVE 1

1. k
2. b
3. h
4. j
5. d
6. c
7. s
8. f
9. q
10. o
11. l

OBJECTIVE 2

Answer should include any six of the following:

- Diameter tape
- Compass
- Steel tape
- Increment borer
- Hypsometer (Biltmore stick or Abney Hand Level)
- Wedge prism or basal area angle gauge
- Clinometer (or Abney Hand Level)
- Map and/or grid layout
- Tally sheet
- Clipboard and pencils

OBJECTIVE 3

Answer should include any three of the following:

- To make land and timber appraisals, determine size, estimate values, and project desirable uses.
- To make estimates and set contracts for timber sales.
- To plan management strategies.
- For special surveys.

OBJECTIVE 4

Answer should include any five of the following:

- Timber values
- Total land area
- Allowable costs
- Topography of the tract
- Uniformity of the stand
- Number of species
- Desired precision or accuracy of the estimate

OBJECTIVE 5

1. a
2. d
3. j
4. i
5. f
6. b
7. g

OBJECTIVE 6

- The cruise is planned ahead of time to guarantee that the sample is large enough and is representative of the whole tract.
- A layout is the plan or design of the cruise and can serve as a kind of map during the sampling.
- In a grid sample, the plots to be sampled are equidistant over the tract.

OBJECTIVE 7

1. a, b, e
2. d
3. Determined by the purpose of the cruise and the value of the timber

   a. count every other tree

   b. measure the borderline trees

OBJECTIVE 8	Refer to answers to Assignment Sheet 1.
OBJECTIVE 9	Refer to Practical Test Ratings for Job Sheets 1 and 2.

OBJECTIVE SHEET

APPLY FOREST MANAGEMENT PRACTICES

XIII

INTRODUCTION

Silviculture is the art and science of producing and tending a forest. It is concerned with the technology of crop production. The production and harvesting of trees benefits our land, cleans our air, protects our soil, provides recreational areas, and supports a vast variety of life forms.

The business, aesthetic, and ecological concerns of forestry must be balanced with the natural and technical processes of planting, maintaining, and harvesting the timber crop. Managing these factors takes years of continuous planning and upkeep.

Managing production and harvest involves several skills. These skills include the ability to integrate knowledge from a number of biological sciences, the ability to set goals and work cooperatively with landowners, and the ability to visualize results over the long-term.

PREREQUISITES

None

UNIT OBJECTIVE

After completing this unit, the student should be able to describe the role of a forest manager, the basic practices of forest management, and forest management systems. The student should recognize principles of regeneration, intermediate cuts, and harvest methods and systems. The student will demonstrate these competencies by completing an assignment sheet, job sheet, and written test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with applying forest management practices to their correct definitions.
2. Choose the correct word or phrase to complete statements about the purpose and scope of forest management.
3. List responsibilities of the forest manager.
4. Define practices of forest management.
5. List advantages and disadvantages of natural and artificial methods of reforestation.
6. Choose the correct word or phrase to complete statements about seeding and planting methods.
7. Select from a list true statements about the types of seedlings.

8. State the purposes of intermediate cutting in forest management.

9. Determine the type of intermediate cut.

10. Choose the correct word or phrase to complete statements about types of harvest cutting.

11. State advantages of harvest cutting systems.

12. Write a report on clearcutting. (Assignment Sheet 1)

13. Demonstrate the ability to plant bareroot seedlings. (Job Sheet 1)

PREPARATION

- Obtain materials to supplement unit.

  NOTE: See Suggested Resources.

- Obtain materials needed to complete the job sheet:

  Planting bar

  Seedlings, 10 per student

- Obtain samples of bareroot, containerized seedlings, and cuttings as well as seeds for common local area trees.

- Review instructional outline for this unit. Modify time frames to suit class needs and plan activities for each class period.

- Study specific objectives to determine those you will cover in your presentation. Decide also which objectives should be taught to which students.

- Determine scope and sequence of objectives that you add. Design and develop support materials, including evaluation techniques, for additional objectives.

- Determine how you will schedule time for students to demonstrate competence in the required procedures.

- Invite a forester or forest management specialist to speak to the class about applying forest management practices.

  NOTE: Supply guest speakers with the specific objectives and any other appropriate sections of the unit.

- Locate examples of even-aged and uneven-aged stands in your area.

- Arrange a field trip or a series of field trips to show students examples of various management techniques: even- and uneven-aged stands, reforestation methods, intermediate cuttings, and harvest cuttings.

- Prepare additional assignments and readings for students interested in the FFA Forestry Contest. Portions of the contest covered in this unit are:

  Section V - Planting equipment

  Section VI - Ability to recognize and understand approved silvicultural practices in the United States: Regeneration methods and timber stand improvement (TSI)

DELIVERY

Objectives 1 through 4

- Stress that silvicultural practices are the result of the cruise and other forest measurements.
- Discuss the variety of sciences a forest manager must use.
- Discuss the local applications of forest management.
- Invite a forest manager to discuss the scope of his or her job, his or her education, various forest management practices, the sciences involved in those practices, and the variety of responsibilities the job entails.
- Relate the four practices to similar activities in home gardens.
- Discuss factors the forest manager would have to consider during each activity, such as wind, rainfall, seeding cycle, wildlife, etc.
- Introduce some basic issues about silviculture methods: cutting old forests and clearcutting. As a result of research in the first case and of public pressure in the second, the U.S. Forest Service is changing its policies. See Suggested Resources.
- Use "Ownership Objectives" exercise in *Project Learning Tree* to clarify how landowners might set objectives for using timberland.
- Show Transparency Master 1 on tools used in planting.

Objectives 5 through 7

- Take students on a field trip to various timber sites.
- Have students identify local tree stands as naturally or artificially generated.

- Display photographs of various tree stands ranging from fruit orchards to Yosemite, to exemplify the reforestation methods at their extremes.

- Have students complete Job Sheet 1 to gain practical knowledge about planting practices.

- Display various planting implements and tools.

- Have students store seedlings for a period of no more than two weeks, following the handling and storing guidelines included in Supplement 1.

Objectives 8 through 10

- View a stand of trees which has not been intermediately cut. Discuss the negative effects on the trees that have survived.

- Visit the site of a recent fire or other natural clearing. Discuss the effect of the fire and the regrowth.

- Observe cutting or pruning in progress. Discuss the reason various cuts are made and their probable effect on the stand.

Objective 11

- Visit areas that have been harvested by the various methods. Compare the growth found, the aesthetic impact, and the usefulness of the area.

- Have students complete Assignment Sheet 1.

- Have students who are willing and capable participate in a group discussion on clearcutting issues.

APPLICATION

Objective 12

- Use Assignment Sheet 1 to encourage students to research and read about a controversial issue and to reinforce writing skills and reasoning, and to distinguish fact from opinion.

- Use Supplement 4 to give studnets ideas on how to separate fact from opinion.

- Show the video *Forestry: An Overview*.

Objective 13

- Have students complete Job Sheet 1.
- Have students care for seedlings for several days before planting.
- Plant the seedlings in an area for public use, allowing the students to enjoy and share the result of their work.
- Have students consider some of the factors mentioned in this discussion of forest management, such as density, danger of insect damage, moisture available, prevailing winds, etc.

EVALUATION

Practical Test

- Explain to students that they will be asked to demonstrate procedures on the job sheet to complete the practical test.
- Describe the rating scale used on the practical test.
- Give practical test.
- Reteach and retest as necessary.

Written test

- Explain to students that they will be asked to demonstrate on the written test actions listed in the specific objectives.
- Give written test.

  NOTE: The written test may be given in sections if desired.
- Evaluate students on assignment sheet activities if not previously done.
- Reteach and retest if necessary.
- Complete appropriate section of competency profiles.
- Review individual and group performance in order to evaluate teaching methods. Adjust scope, sequence, or instructional approaches for additional lessons as required.

SUGGESTED RESOURCES

Publications

NOTE: If *Reader's Guide to Periodical Literature* and back issues of publications are not available in a library in your area, contact your county extension agent for resource suggestions.

Also: Forest Service - USDA
P.O. Box 96090
Washington, D.C. 20090-6090

"Releaf For Greenhouse? Don't Cut Old Forests," *Science News*, February 10, 1990, Vol. 173, No. 6, p. 85. Summarized from *Science*, February 9, 1990. It has been thought that replacing old-growth forests with new, young timber would help slow the "greenhouse effect" by slowing the accumulation of carbon dioxide in the atmosphere. It has been found that cutting old trees actually adds carbon dioxide to the atmosphere.

Speakers

Oklahoma Natural Resources Speakers Bureau sponsored through Oklahoma State University, Division of Agriculture, Oklahoma Cooperative Extension Service - Forestry, Oklahoma Conservation Commission and the Oklahoma Forestry Association. Lists speakers on a variety of forestry-related topics. Speakers operate on a time-available basis. Request a listing of speakers, programs, slide presentations and videotapes from your local extension office or from:

Dr. Steve Anderson
Forestry Dept.
Oklahoma State University
239 Agricultural Hall
Stillwater, OK 74078
(405) 744-9431

Dave Marcouiller
Forestry Dept.
Oklahoma State University
242 Agricultural Hall
Stillwater, OK 74078
(405) 744-5444

Teachers from outside of Oklahoma should contact the Forestry Extension Office in their state.

Audiovisual Materials

Forestry: An Overview, 20 min., color video, Centre Productions, 1987. Discusses silviculture methods, especially clearcutting and its opposition by environmentalists who argue that it alters the ecological balance too radically. Looks at cutting mature trees and leaving the others for wildlife habitat.

Available from WSU/UI Regional Media collection: Regional Media Center, Instructional Media Services Washington State University, Pullman, Washington 99164-5602, (800) 527-7012, Ext. 978, Order No.11881.

The following materials are available on a free-loan basis from the Forestry Extension Program at Oklahoma State University, 242 Agricultural Hall, Stillwater, OK 74078, (405) 744-5444.

- *Trees for 2001: Today's Foresters in Action*, 17 min., 116 slides with cassette and script, American Forest Institute. Covers basic concepts of forest management through the eyes of people in forest-related jobs. Helps students develop an understanding of how and why forests are managed.
- *Growing More Wood*, 19:30 min., VHS, Dupont. Discusses site preparation and release trees; discusses use of Oust and Velpar herbicides.
- *Tree Planting Techniques*, 14:18 min., VHS, Cooperative Extension Service, Tuskegee University. Discusses proper tree planting techniques and site preparation.
- *Make 'Em All Count*, 11:30 min., VHS, U.S. Forest Service, Atlanta, Georgia. Discusses proper seedling care and handling and proper planting techniques.
- *Best Management Practices for Logging*, 12 min., VHS, Virginia Cooperative Extension Service. Discusses elements of BMP including road construction, pre-harvest planning, harvesting and streamside management zones.
- *Great American Woodlot Series*, 30 min., six segments per program. VHS, Maine Cooperative Extension Service. Thirteen half-hour programs aired on Public Broadcasting Service and covering discussions with tree farmers on forest management, wildlife management, tree planting and many other topics.
- *Forest Management and the South's Environment*, 80 slides with cassette, Southern Forest Institute. How proper forest management improves the quality of Southern woodlands.
- *The Seed Tree Method of Pine Regeneration*, 7:30 min., 39 slides with script; OSU Extension Forestry. Outlines the basis for timber stand improvement. Describes proper thinning techniques to optimize forest growth.
- *Regeneration by Shelterwood*, 7 min., 56 slides with cassette, University of Georgia, Cooperative Extension Service. Describes the rationale, processes, and effects of shelterwood cutting.

UNIT REFERENCES

- Anderson, David A. and I. I. Holland, *Forests and Forestry*, The Interstate Printers and Publishers, Inc., Danville, Illinois, 1982.

- Collins, B. McManus and Fred M. White, *Elementary Forestry*, Reston Publishing Company, Inc., Reston, Virginia, 1981.

- Craighead, Max R., *Farm Woodland Improvements*, OSU Extension Facts No. 5015, Oklahoma State University, Stillwater, Oklahoma, n.d.

- Donovan, David D., *Tree Planting Objectives and the Seedling Selection Process*, OSU Extension Facts No. 5023, Oklahoma State University, Stillwater, Oklahoma, n.d.

- *Early Protection and Care for Planted Seedlings*, OSU Extension Facts No. 5025, Oklahoma State University, Stillwater, Oklahoma, n.d.

- *Harvesting Forest Products*, Texas A & M, College Station, Texas, 1976.

- Hill, Deborah Brooks, *Small Woodlot Management in Kentucky*, University of Kentucky, College of Agriculture, Cooperative Extension Service, FOR-15, n.d.

- *Planting and Care of Tree Seedlings*, OSU Extension Facts No. 5002, Oklahoma State University, Stillwater, Oklahoma, n.d.

- *Seedling Availability, Planting, and Initial Care*, OSU Extension Facts, No. 5024, Oklahoma State University, Stillwater, Oklahoma, n.d.

- Smith, David M., *The Practice of Silviculture*, John Wiley & Sons, New York, 1986.

- Stoddard, Charles H. and Glenn M. Stoddard, *Essentials of Forestry Practice*, John Wiley & Sons, New York, 1987.

OBJECTIVE 1

Match terms associated with applying forest management practices to their correct definitions.

- **Even-aged**—A stand in which relatively small age differences exist between individual trees
- **Forestation**—The establishment of forest naturally or artificially upon areas where it is has been absent or insufficient
- **Forest management**—The application of business methods and technical forest principles to the operation of forest property
- **Heel-in**—To store young trees prior to planting by placing them in a trench and covering the roots with soil
- **Improvement cutting**—A cutting made in a stand that is past the sapling stage; improves composition and character of the stand by removing trees of less desirable species, form, and condition
- **Reforestation**—The natural or artificial restocking of an area with forest trees

  NOTE: Reforestation usually refers to artificial restocking under the adopted plan of management.
- **Seedling**—A tree grown from seed; usually restricted to trees smaller than saplings
- **Selection**—Removal of selected trees at relatively short intervals, commonly 5 to 20 years, repeated indefinitely

  NOTE: Selected trees are often the oldest and largest trees in a stand.
- **Stand**—A group of trees or other growth occupying a specific area and sufficiently uniform in composition (species), age, arrangement, and conditions as to be distinguishable from the forest or other growth on adjoining areas

- **Timber Stand Improvement (TSI)**—Management practices to improve the quality and value of the trees in a stand

  NOTE: TSI includes many activities and practices and is the recommended procedure for newly-acquired forest land or for previously unmanaged land. Standard practices are thinning, removing cull trees, release cutting, and site preparation for reforestation. See Objective 10.

- **Uneven-aged**—A stand in which there are considerable differences in the ages of the trees and in which three or more age classes are represented.

OBJECTIVE 2 **Choose the correct word or phrase to complete statements about the purpose and scope of forest management.**

NOTE: While forest management usually refers to the timber industry, it may also refer to similar functions in recreation, wildlife protection, water control, or environmental protection.

- The forest manager manipulates the development and maintenance of forest crops to produce the ideal objectives of the management plan and the desired product in the shortest time possible.
- Every stand is different because of species, size, age, growth rate, soil conditions, water, fungal or insect infestation, etc., so each requires its own management plan.
- Forest managers use a cruise to study the stand. With that information, plus knowledge of the environmental factors affecting the stand, they can advise landowners about the best uses for the land.
- Landowners' goals and objectives determine the management plan to be designed, implemented, and maintained by the forester.

  EXAMPLES: Immediate harvest and sale
  Clear unwanted or less valuable trees for housing development
  Create a wildlife habitat and hunting area
  Intensive management for maximum growth over the long term

- Forest management is an ongoing process. Managers must consider the same environmental influences any farmer must deal with: soil type, water supply, wind, erosion, disease or insect infection, etc. They must also consider long-range survival of the crop. A stand of trees may grow 100 years or longer before harvest, and changes in the environment and in the industry will affect management practices as it grows.

- Management plans must also consider the overall ecological balance, insuring the continuation of the crop, protection of wildlife habitat, watershed, and soil quality, as well as aesthetic and/or recreational enjoyment.

  EXAMPLES: Decisions will always consider the best reforestation method according to the management goals.

  Roads must be built with proper drainage to avoid erosion.

  As harvested areas are reforested with softwoods, there is concern that too few hardwoods will be available to maintain habitats for certain birds and the insects they feed on.

  Clearcutting has become a major controversy because of aesthetics and ecological balance.

  Good management practices are increasingly important for streamside and greenbelt management.

- Best Management Practices (BMP) is a voluntary program for foresters, landowners, and logging contractors to do what is good for the environment as part of the management and harvest plans.

OBJECTIVE 3

List responsibilities of the forest manager.

- Helps landowners determine goals according to the landowners' objectives and characteristics of the stand.
- Develops a management plan to achieve the goals.
- Oversees the planting, growth and maintenance, and harvesting of the timber crop.
- Monitors the density of the stand, thinning as needed.

- Prescribes long-range harvesting, thinning, and planting plans.
- Determines the rotation, species, and management system used.
- Protects the crop from dangers such as fire, infection, and wildlife damage.
- Adapts the plan to provide alternatives as conditions change.
- Monitors the site, including the soil, climate, and noncrop growth.

OBJECTIVE 4

Define practices of forest management.

The four basic practices of forest management are:

- **Silviculture**—The theory and practice of controlling forest establishment, composition and growth. Silviculture deals basically with the growing, shaping, and maintenance of tree stands.
- **Reproduction**—The process by which a forest or range is renewed. The two basic methods of reproduction are artificial and natural.
- **Creating a new stand**—The process of growing a stand of trees where one did not exist before.
- **Harvest cutting and stand renewal**—Harvesting is removing trees from a stand to process and market the wood. Stand renewal is seeding or planting the next generation of trees or the steps taken to insure natural reproduction.

OBJECTIVE 5

List advantages and disadvantages of natural and artificial methods of reforestation.

Natural methods—Those found in nature.

EXAMPLES: Seed dropped or thrown by trees, seeds carried and dropped by wind or wildlife.

- **Advantages of natural methods**
    - Inexpensive
    - On-going
    - Offers more variety
- **Disadvantages of natural methods**
    - Poor stand development (density, poor parent stock)
    - Poor seed placement
    - Unreliable, inconsistent results

Artificial methods—Those provided by man.

EXAMPLES: Planting or distributing seeds or seedlings

- **Advantages of artificial methods**
    - Greater ability to control the quality of the stand
    - Ability to reforest quickly
    - Ability to create a new stand
    - Ability to change stand compositions

      EXAMPLE: From low-value hardwood to high-value pine
- **Disadvantages of artificial methods**
    - Expense
    - Labor intensive

OBJECTIVE 6

Choose the correct word or phrase to complete statements about seeding and planting methods. (Supplement 1, Transparency Master 1, Job Sheet 1)

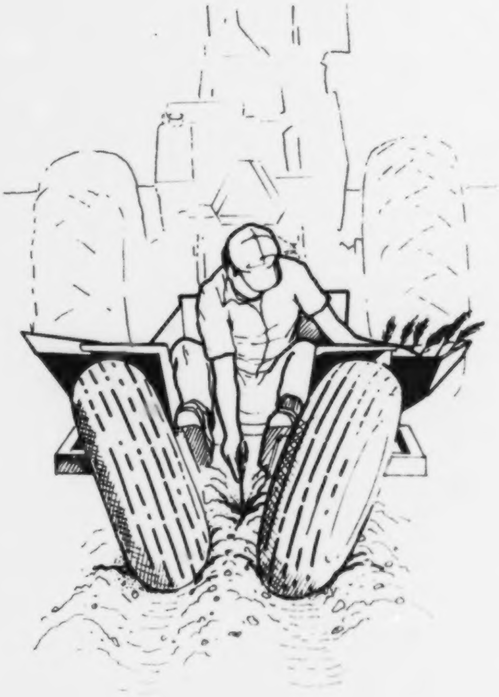
Seeding methods

- Seeding is initially less expensive and less labor-intensive than planting, but can result in heavier losses, and may require a thinning cut earlier than seedling-planting methods.

- **Broadcast seeding**—Spreading seeds over a broad area of ground and allowing them to remain on top of the soil. Broadcast seeding can be done by aerial application or ground application.

  NOTE: Until the 1960's aerial application was popular, but is used less today because of poor control, and because new planting methods offer better, more economical control.

- **Strip and spot seeding**—Seeds are placed by machine or by hand in chosen spots or strips, singly or in small groups, and covered with soil.



Planting Machine

Courtesy of Oklahoma State University Cooperative Extension Service.

Planting methods

- Seedlings are usually grown in nurseries through one or two seasons then transplanted. Seedlings may have a healthier start and allow for a more controlled density; however, they are more expensive, require more labor, and take more time.
- Improper planting is one of the most common causes of seedling failure.
- There are two common methods of planting: digging a hole and compression methods. Compression methods use a hole made by pushing the soil aside with a sharp planting tool, then pressing the soil back around the roots after the seedling is in place. Compression is preferred because it's faster than digging a hole. The advantage of digging a hole is that the roots can be more completely covered with soil.

OBJECTIVE 7

Select from a list true statements about the types of seedlings.

- **Bareroot**—These seedlings include only the stem and roots. Advantages of bareroot seedlings are that they are easy to produce, inexpensive, easy to plant, and easy to use with mechanical planting equipment. Disadvantages center on the exposed roots which are subject to harsh and uncontrolled environments.
- **Containerized**—These seedlings are stored in various containers, including peat pots and styroblocks. The advantage of this system is that the roots are protected. Also, they can be raised in greenhouses, in climates similar to the climate where they will be raised. Containerized seedlings are difficult to transport, store, and transplant. They are also more expensive.
- **Cuttings**—Not actually seedlings, cuttings are small branches of the trees which can root and grow if planted. They are easy to make, store, ship, and plant. Disadvantages are that cuttings can't be used with all species of trees, may require the application of a root promoting agent, and require a high degree of technical knowledge.

OBJECTIVE 8

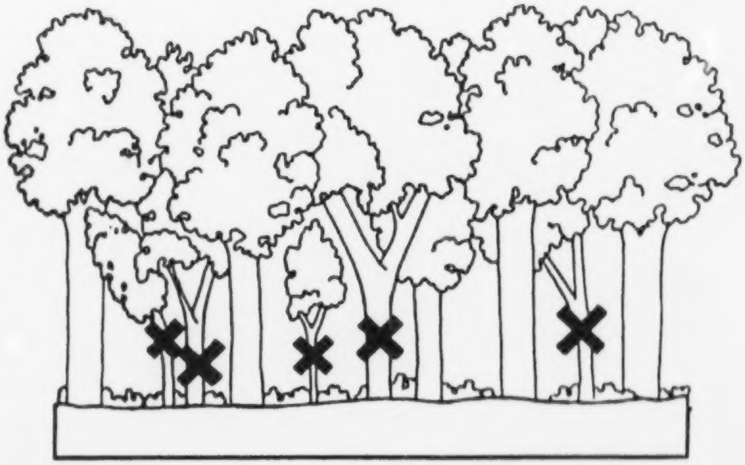
State the purposes of intermediate cutting in forest management. (Supplement 2)

Cutting between the reforestation and harvesting stages is called intermediate cutting. Its purposes, according to the goals and objectives of the management plan, are:

- To improve the existing stand by removing defective or undesirable trees.
- To improve the existing stand by reducing stand density.
- To protect the stand by removing trees infected by insects or disease.
- To realize an early profit from the sale of the removed trees.

OBJECTIVE 9 **Determine the type of intermediate cut.** (Supplement 3)

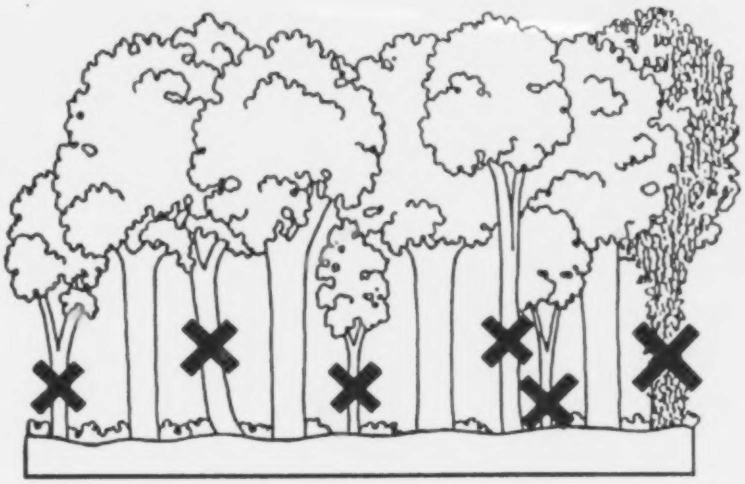
- **Precommercial thinning**—Done during the sapling stage to remove undesirable trees of about the same age. "Undesirable" means trees that are poorly formed, defective, or over-topping the desired species. The operation allows the desirable species to have more moisture, sunlight, and nutrients, since competition is reduced. Similar to weeding, this is the first silvicultural practice applied following the establishment of a stand.



Precommercial Thinning

From "Small Woodlot Management" and used with permission of the author, Deborah Brooks Hill, Ph.D., University of Kentucky.

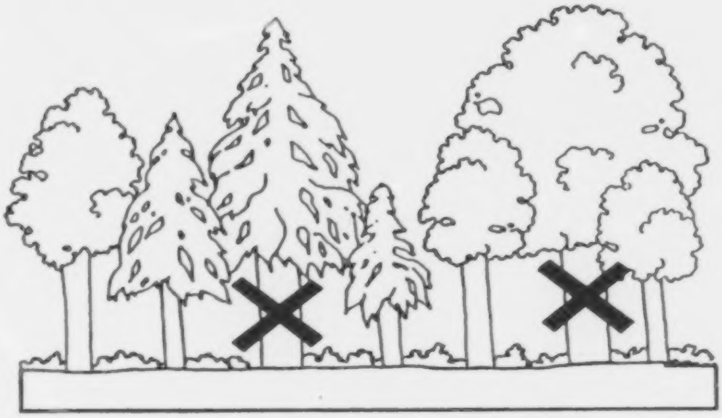
- **Post/pulpwood cutting**—Takes out smaller products in immature stands that are fully stocked. Stimulates growth and increases the total yield of useful products on the stand. Provides the first income from a stand. Performed in a stand in which all trees are basically healthy, but crowded. Competition for such things as soil, moisture, light, and nutrients becomes so intense that the growth rate is reduced. The objective is to redistribute the growth to selected trees. The better trees are left, less valuable trees are removed.



Post/Pulpwood Cutting

From "Small Woodlot Management" and used with permission of the author, Deborah Brooks Hill, Ph.D., University of Kentucky.

- **Release cuttings**—These cuttings free or remove from competition the older, overtopping trees where a young stand is growing underneath. The young trees are "released" to grow. The best way to remove older trees is to cut them for commercial harvest.



Release Cutting

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- **Improvement cuttings**—Removes crooked, forked, diseased, dead, or undesirable trees. May be used as a preventive measure against outbreaks of forest pests. Improvement cuttings are generally used in older stands that have not had the benefit of precommercial or release cuttings.

- **Salvage cut**—Diseased or insect-infested trees are cut and sold.

OBJECTIVE 10

Choose the best word or phrase to complete statements about types of harvest cutting.

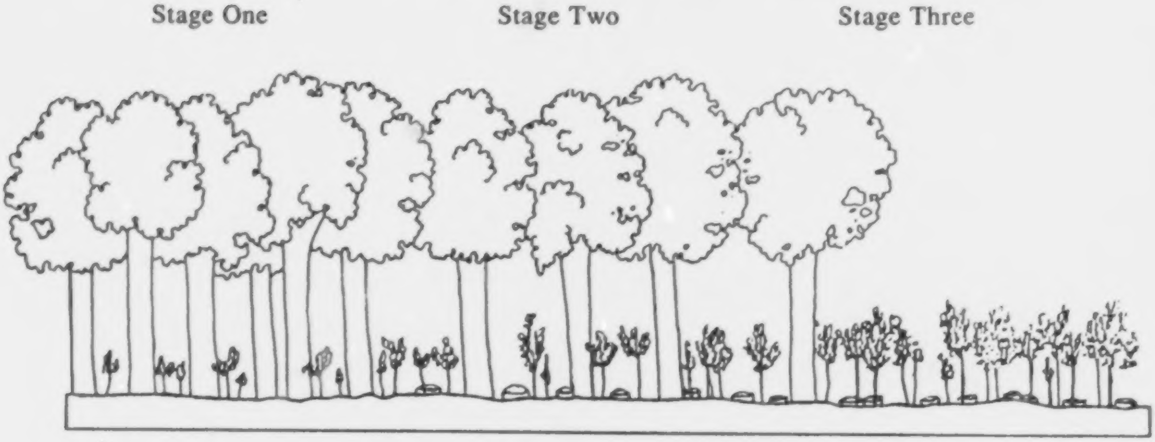
Even-aged management systems

- **Clearcutting**—Removes all trees from the stand in one cut, although some trees may be left for specific reasons such as wildlife habitat. This process maximizes sunlight for new tree growth. Complete reforestation will be required.

  NOTE: The area on which the entire timber stand has been cut is called a clearcut or clearcutting.

- **Shelterwood cutting**—Removal of the mature timber in a series of cuttings, extending over a period of years.

  Approximately half the trees are removed and new trees are grown from seed or are planted, if needed. The older trees provide shelter for the younger trees, protecting seedlings from winds, snow, sunscald, etc., until they are established. At that time, the remaining older trees are also harvested.



Shelterwood Cutting

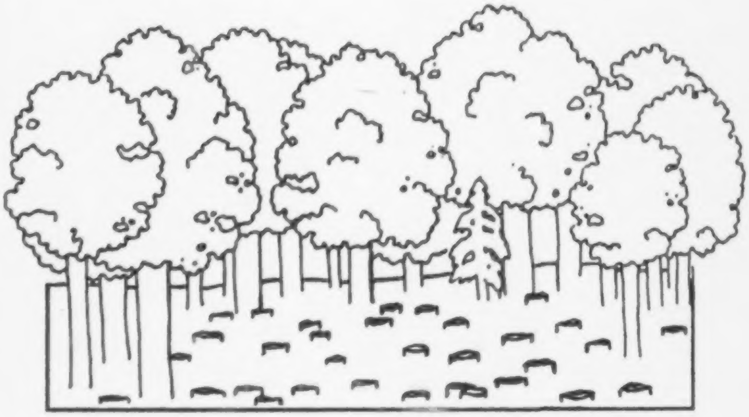
Adapted from "Small Woodlot Management" and used with permission of the author, Deborah Brooks Hill, Ph.D., University of Kentucky.

- **Seed tree cutting**—Removal of the mature timber in one cut, except for a small number of trees left singly or in small groups to reseed the stand.

  Most of the trees are removed. The remaining trees are good seed producers which regenerate the stand and then are harvested.

Uneven-aged management systems

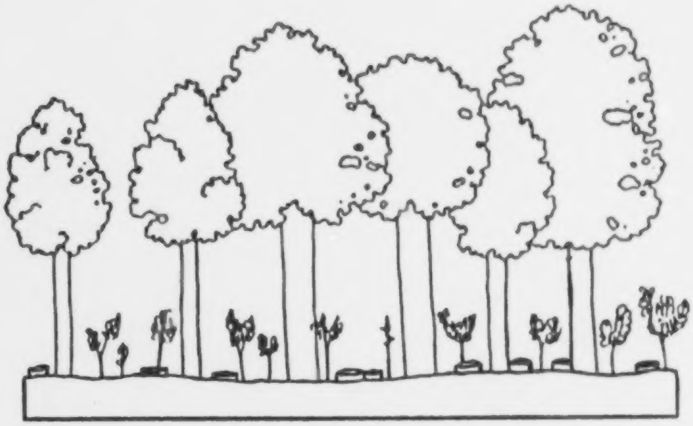
- **Group selection**—Small groups of trees are removed, creating openings for sunlight required to regenerate the stand.



Group Selection

Adapted from "Small Woodlot Management" and used with permission of the author, Deborah Brooks Hill, Ph.D., University of Kentucky.

- **Individual tree selection**—Trees are harvested individually based on their size and other desirable characteristics. Their harvesting creates small openings for sunlight for younger trees.



Individual Tree Selection

Adapted from "Small Woodlot Management" and used with permission of the author, Deborah Brooks Hill, Ph.D., University of Kentucky.

OBJECTIVE 11

State advantages of harvest cutting systems.
(Assignment Sheet 1)

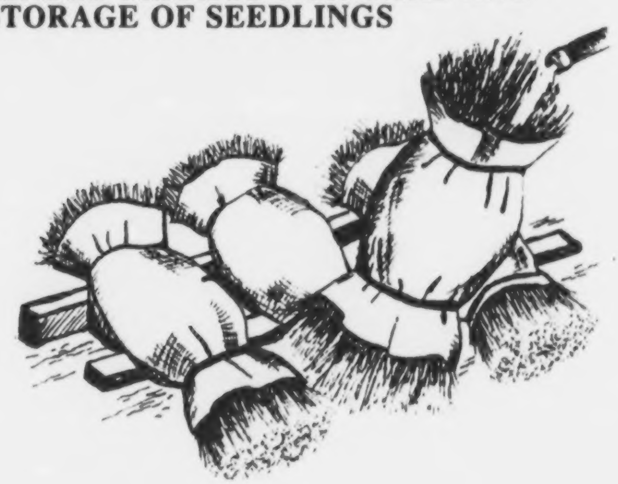
- **Clearcutting**
    - Allows maximum sunlight for new stand
    - Allows reforestation with a more desirable species
    - Allows greatest control of next crop placement
    - Provides fast growth of new crop
    - Least expensive harvesting process

- **Shelterwood cutting**
  - Allows protection for new crop
  - May be more aesthetically pleasing than total clearcutting
- **Seed tree cutting**
  - Allows continuation of proven stock
  - Allows natural seeding on clearcut land
- **Group selection**
  - Provides sunlight for young plants while maintaining the stand
  - Less expensive than individual tree selection
- **Individual tree selection**
  - Allows each tree to reach its potential
  - Provides aesthetically pleasing forest recreation areas in addition to a cash crop

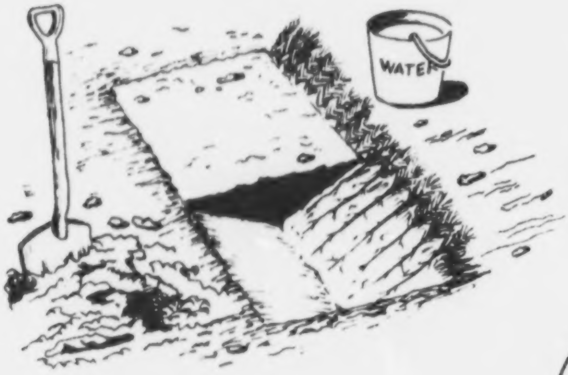
RECOMMENDED METHOD FOR CARE AND STORAGE OF SEEDLINGS

PACKAGE STORAGE

avoid freezing
allow ventilation
keep moist
raise one end for drainage
store in cool shady place



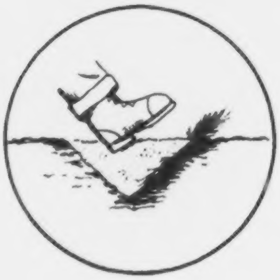
ALTERNATE METHOD FOR STORAGE OF SEEDLINGS



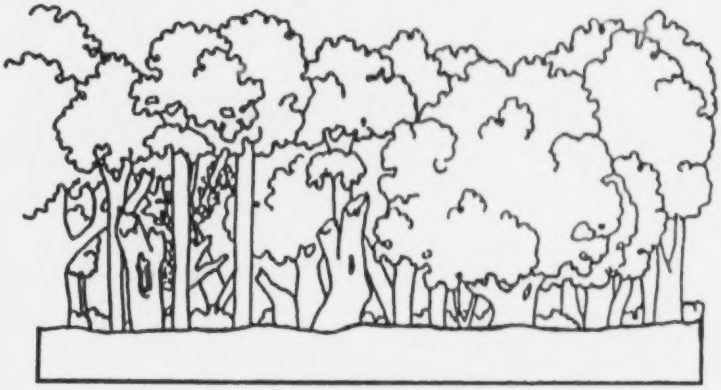
HEELING IN

dig V-shaped trench
break bundles
spread seedlings
cover roots with soil
dampen with water

firm gently



CUTS FOR DIFFERENT MANAGEMENT OBJECTIVES



Unmanaged

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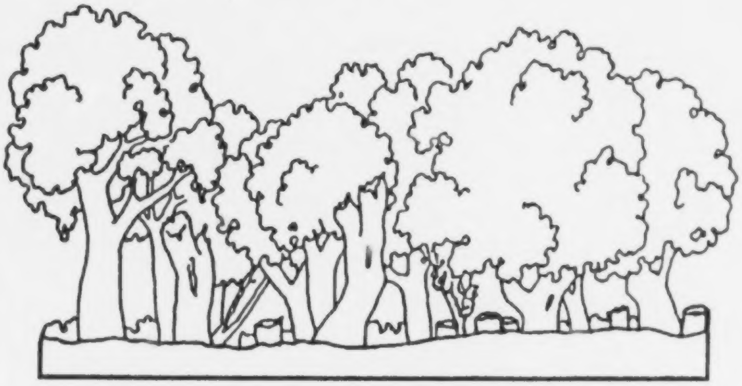

Managed for Wildlife Only

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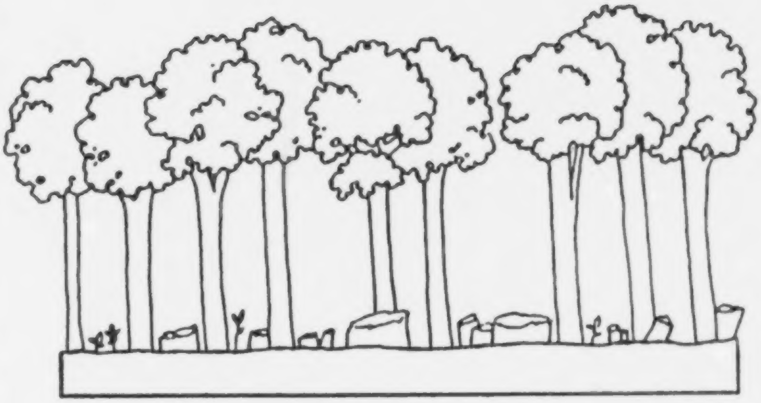

Managed for Sawlogs Only

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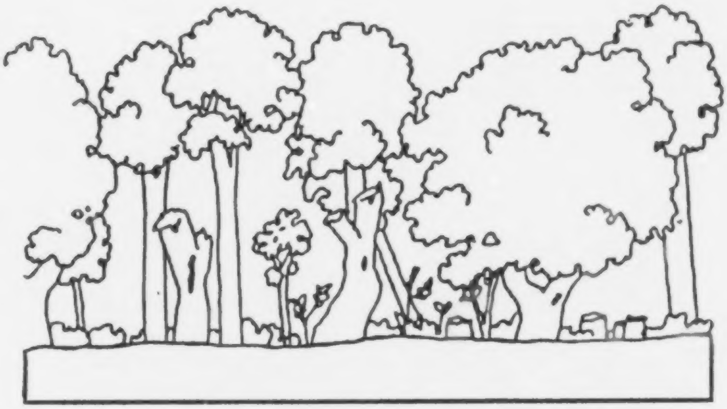


Managed for Wildlife and Sawlogs

Adapted from "Small Woodlot Management" and used with permission of the author, Deborah Brooks Hill, Ph.D., University of Kentucky.

Timber Stand Improvement Procedures

Prescribed burning—Most economical way of controlling scrub hardwood.

Cutting—Limited use where chemical control is not advisable.

Basal spraying—Applying herbicide around the base of the tree; very selective and reliable method.

Injecting herbicide—Deadens cull trees; most selective of any herbicide treatment.

Spraying foliage—Effective for widespread control in late spring and early summer.

Soil sterilants—Limited use.

Thinning Operations

Low thinning (sometimes called thinning from below)—The lower trees are removed.

Crown thinning (sometimes called thinning from above)—The taller trees are removed, opening the canopy.

Selection thinning—Dominant trees are removed.

Mechanical thinning—Trees are removed according to a predetermined spacing pattern, with little or no regard to their health or size.

DISTINGUISH BETWEEN FACTS AND OPINIONS

Facts

- Describe the world as it is known *at the time the item was measured.*

  4,016 people voted against increased taxes.

- There are no "good" or "bad" facts—but they may be used to achieve the specific purpose of the user; the use may be ethical or unethical (look up these words).

  The U.S. Forest Service: "We are harvesting about 1% of the available timber in this forest area."

  The purpose is to describe the amount of timber relative to the overall area and to persuade the public that it is not a major amount.

  Literature urging people to send money to preserve the area: "The U.S. Forest Service is cutting *18.6 million* acres.

  The purpose is to suggest that the Forest Service is cutting a vast amount of timber and to arouse anger so people will be persuaded to send money.

  The "fact" is that 18.6 million acres and 1% of the forested area represent the same amount of land.

- Watch for signal words that show you how the fact is used:

  EXAMPLE: *Only* 30% of the population are in favor of the bill.

  As many as 30% or one third of the population are in favor of the bill.

- Facts change as new information becomes available. A poll conducted last month may not indicate the way people feel now.

Opinions

- Describe people's thoughts or feelings about facts.

  EXAMPLE: "The people who voted against increased taxes were voting against improved education."

  "Everything you ever wanted in a pair of shoes."

- Opinions are not more or less valuable than facts. An informed opinion is a valid application of facts, especially from an expert.

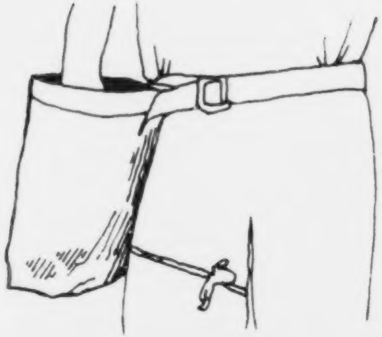
- In order to evaluate an opinion you must evaluate the source and the purpose.

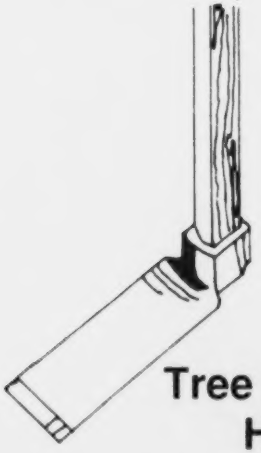
- Watch for emotionally-charged words or pictures that are meant to persuade you by arousing anger, assigning unrealistically high or low values to people or policies, making you feel sorry for people, animals, etc.

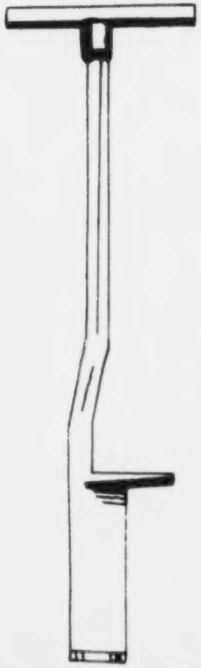
  Emotional appeals are very strong, and they are not "wrong." But you must be able to judge and value for yourself whether the appeal is truthful and appropriate or exaggerated and inappropriate. Look for and evaluate emotional appeals from the facts and opinoins above.

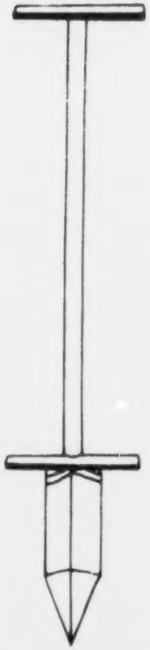
TRANSPARENCY MASTER 1 Forestry
XIII - 33

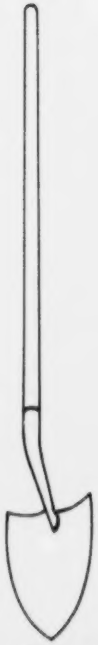
Hand Planting Tools


Tree Planting Bag

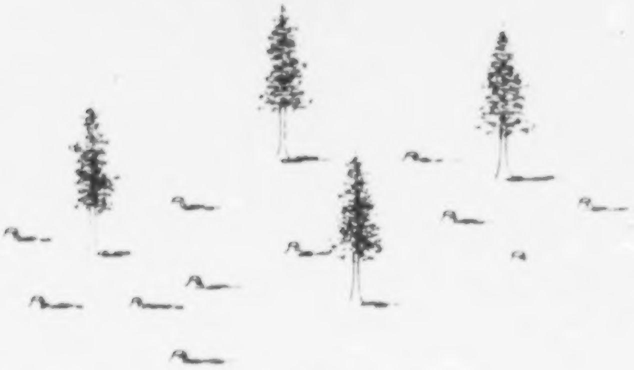

Tree Planting Hoe


Planting Bar

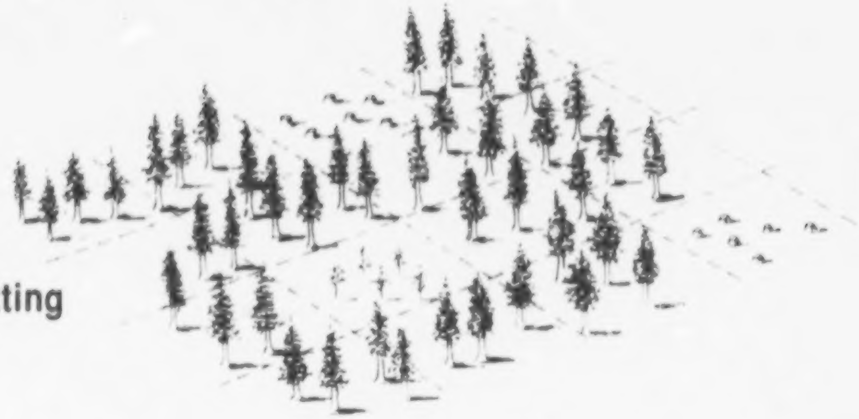

KBC Bar


Long-handled Shovel

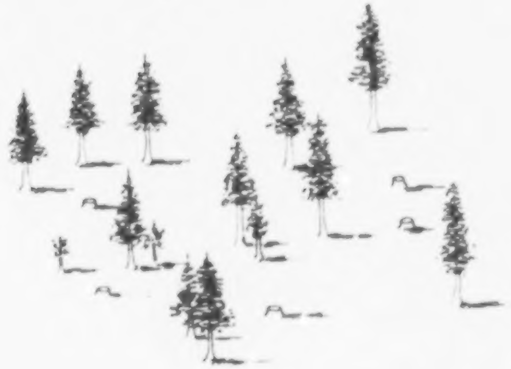
Principal Harvest Cutting Methods



Seed Tree



Clear-cutting



Selection

REPORT ON A TOUR OF MANAGED FOREST SITES WITH A FORESTER GUIDE

Write an "X" in the blank before each example you see. Provide additional information you learn on the tour.

Management Systems

___ Even-aged ______________________________

____

___ Approximate age of stand ______________________________

____

___ Uneven-aged ______________________________

____

___ Approximate age of oldest trees ______________________________

____

Reforestation Methods

___ Natural ______________________________

Describe the stand

____

____

____

____

___ Artificial ______________________________

Describe the stand

____

____

____

____

Intermediate Cuttings

___ Precommercial ______________________________

____

___ Post/pulpwood ______________________________

____

___ Release ______________________________

____

___ Improvement ______________________________

____

___ Salvage ______________________________

____

Harvest Cuttings

___ Clearcutting ______________________________

____

___ Shelterwood ______________________________

____

___ Seed-tree ______________________________

____

___ Group selection ______________________________

____

___ Individual selection ______________________________

____

ASSIGNMENT SHEET 1

APPLY FOREST MANAGEMENT PRACTICES

XIII

NAME ______________________________ SCORE _______

OBJECTIVE 12

Write a report on clearcutting.

INTRODUCTION

Clearcutting has become a major controversy between environmental protection groups and the forestry industry. Public opinion is influenced by emotional appeals to "save the wildlife." But public opinion is also influenced by facts and by education.

You are to do your own research on clearcutting arguments, from either position, and then write a report on your research. Include a statement of your own opinion, and an evaluation of facts and opinions used in the article.

Proper grammar and spelling are part of the grade.

DIRECTIONS

1. Write down your opinion on clearcutting.
2. Go to a public library, school library, or university library. Ask the librarian to show you the *Reader's Guide to Periodical Literature* or the computerized "search" program and how to use it.
3. Select a 1-year period since 1975 and locate at least two articles on clearcutting from two different magazines.

   NOTE: Try to find articles with different positions. An article from *American Forests* and one from *National Geographic* are likely to have different ideas.
4. Read the articles and take notes, including the title of the article, the author, the name of the magazine, the date of publication, and the page numbers.
5. Summarize the content: Write down the main points, the major participants in the controversy (Sierra Club, U.S. Forest Service, etc.), any important statistics, and the conclusion reached by the author.

6. Write your report, no more than three pages. Include:

   a. Your original statement on clearcutting, written before you did your research.

   b. A report on the articles you read.

   c. A paragraph on the authors' use of facts and opinions with examples of each as appropriate.

   d. A statement of your position since reading the articles.

   e. A list of your articles, labeled "References," listed in alphabetical order, in this form: Author, name of article in quotes, name of magazine underlined, date, and page numbers. Use the punctuation shown below.

   EXAMPLE:

   References

   Doe, John, "An Article on Clearcutting," *Forestry Facts*, April, 1988, pp. 21-22.

   If the author's name is not with the article, begin with the name of the article.

   NOTE: The best approach is to write a "rough draft" to be corrected and rewritten in a "final draft." Have someone check your report for proper grammar and spelling. Be sure your final draft is neat and easy to read.

ASSIGNMENT SHEET 1

Student must submit a written report, no more than three pages, including:

1. A statement of student's original position on clearcutting.
2. A report on the articles the student read.
3. A paragraph on the authors' use of fact and opinion with examples of each as appropriate.
4. A statement of student's position since reading the articles.
5. References

Evaluate proper grammar, spelling and neatness.

APPLY FOREST MANAGEMENT PRACTICES

OBJECTIVE 13

Plant bareroot seedlings.

TOOLS AND MATERIALS

- Planting bar
- Bucket
- 50′ tape
- 10 pine seedlings
- An area to plant indicated by the instructor
- Markers such as flagging tape, stakes, rocks, etc.

PROCEDURE

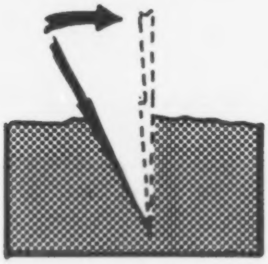
CAUTION: Make sure seedlings are kept moist before and during the procedure.

1. Measure and/or pace the required distances and mark:

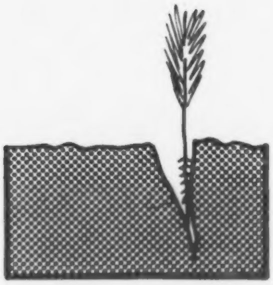
   6′ x 8′ section, with 8" between rows and 6" between seedlings in the row

2. Plant seedlings using the following procedure (called the bar-slit method).

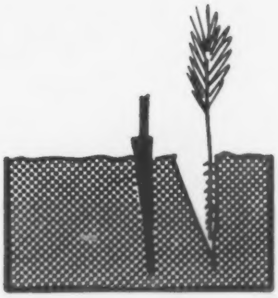
   CAUTION: Set seedling in hole so that roots are straight down, not bent upward in a u-shape.



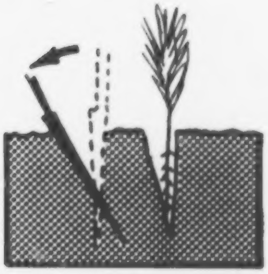
1. Insert bar at angle shown and push forward to upright position



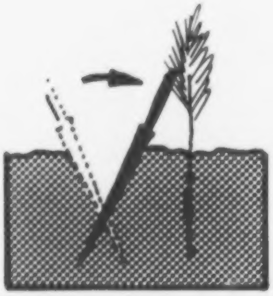
2. Remove bar and place seeding at correct depth



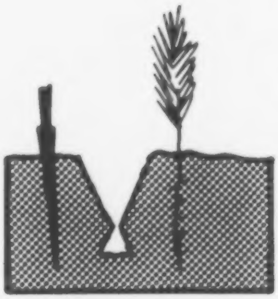
3. Insert bar 2 inches toward yourself from seedling



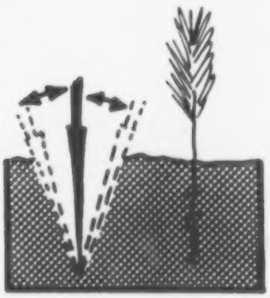
4. Pull handle of bar toward yourself to firm soil at bottom of roots



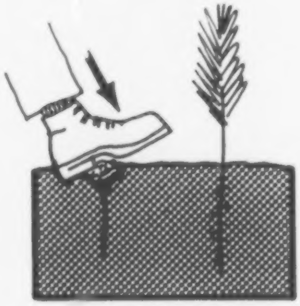
5. Push handle of bar forward to firm soil at top of roots



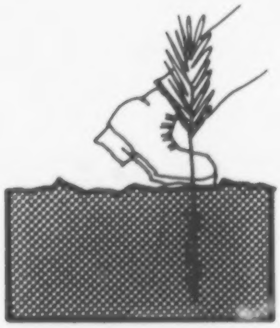
6. Insert bar 2 inches from last hole



7. Push forward then pull backward to fill hole



8. Fill in last hole by stamping with heel



9. Firm soil around seedling with the foot

3. Check planting:
    a. After planting the seedlings, choose at random and dig up two seedlings for inspection of correct planting technique.
    b. Hold three needles and pull upward. If the plant comes up, it was planted too loosely.
    c. If seedling does not pull out of the ground, use the pry bar to gently dig it up, watching closely for the criteria listed in the key.
4. Evaluate the technique using the chart below on page 46. If any of the conditions listed are present in the plants checked, the seedling was not planted correctly. Write an "X" in the space if the condition is present.
5. Replant the seedlings.
6. Have your instructor check your work and turn in the chart for evaluation.
7. Clean and put away tools properly.

Name ____

Condition	Tree #1		Tree #2	
	Yes	No	Yes	No
1. Seedling loose, pulls up using three needles to pull				
2. Packing hole not filled				
3. Seedling U-rooted				
4. Lateral roots wrapped around seedling				
5. Seedling planted too deep - more than 2" on the root crown				
6. Seedling planted too shallow - root crown exposed				
7. Air space in the planting hole				
8. Planting hole open at the top				

JOB SHEET 1

Plant bareroot seedlings using the bar-slit method.

Student's name ______________________ Date __________

Evaluator's name ______________________ Attempt no. _____

Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

Evaluator note: Write a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.

The student:	YES	NO
1. Measured and/or paced the required distances and marked a 6′ x 8′ section, with 8" between rows and 6" between seedlings in the row.	______	______
2. Planted seedlings using the following procedure for the bar-slit method:	______	______
a. Inserted bar at the angle shown and pushed forward to upright position.	______	______
b. Removed bar and placed seedling at correct depth.	______	______
c. Inserted bar 2 inches toward self from seedling.	______	______
d. Pulled handle of bar toward self to firm soil at bottom of roots.	______	______
e. Pushed handle of bar forward to firm soil at top of roots.	______	______
f. Inserted bar 2 inches from last hole.	______	______
g. Pushed forward then pulled backward to fill hole.	______	______
h. Filled in last hole by stamping with heel.	______	______
i. Firmed soil around seedling with the foot.	______	______

The student:	YES	NO
3. Checked planting:		
a. After planting the seedlings, chose at random and dug up two seedlings for inspection of correct planting technique.	____	____
b. Held three needles and pulled upward. If the plant came up, it was planted too loosely.	____	____
c. If seedling did not pull out of the ground, used the pry bar to gently dig it up, watching closely for the criteria listed in the chart.	____	____
4. Evaluated the technique using the chart.	____	____
5. Replanted the seedlings.	____	____
6. Used proper tools correctly.	____	____
7. Performed steps in a timely manner.	____	____
8. Practiced safety rules throughout procedure.	____	____
9. Provided satisfactory responses to questions asked.	____	____
10. Put away tools and cleaned work area.	____	____

EVALUATOR'S COMMENTS

____

____

____

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See performance evaluation key). A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:

	4 Measured and marked area accurately	3 Measured and marked area within 1 ft	2 Measured and marked area within 2 ft	1 Error exceeds ± 2 ft
	4 Correctly planted 10 seedlings	3 Correctly planted 9 seedlings	2 Correctly planted 8 seedlings	1 Correctly planted fewer than 8 seedlings
	4 Evaluation chart: 2% error	3 Evaluation chart: 3% error	2 Evaluation chart: 4% error	1 Error 5% or more

EVALUATOR'S COMMENTS

____

____

____

AVERAGE RATING

Evaluator note: To obtain an average rating for the competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

PERFORMANCE EVALUATION KEY

4 - Skilled—Can perform job with no additional training

3 - Moderately skilled—Has performed job during training program, limited additional training may be required

2 - Limited skill—Has performed job during training program; additional training is required to develop skill

1 - Unskilled—Is familiar with process, but is unable to perform job

NAME ______________________________ SCORE _______

OBJECTIVE 1

Match terms associated with applying forest management practices to their correct definitions. Write the correct letter in the blank.

____ 1. The natural or artificial restocking of an area with forest trees

____ 2. A group of trees or other growth occupying a specific area and sufficiently uniform in composition (species), age, arrangement, and conditions as to be distinguishable from the forest or other growth on adjoining areas

____ 3. A tree grown from seed; usually restricted to trees smaller than saplings.

____ 4. A stand in which relatively small age differences exist between individual trees

____ 5. To store young trees prior to planting by placing them in a trench and covering the roots with soil

____ 6. Removal of selected trees at relatively short intervals, commonly 5 to 20 years, repeated indefinitely

____ 7. The establishment of forest naturally or artificially upon areas where it is has been absent or insufficient

____ 8. The application of business methods and technical forest principles to the operation of forest property

____ 9. Management practices to improve the quality and value of the trees in a stand

____ 10. A cutting made in a stand past the sapling stage for the purpose of improving its composition and character by removing trees of less desirable species, form, and condition in the main crown canopy

a. Even-aged
b. Forest management
c. Forestation
d. Heel-in
e. Improvement cutting
f. Intermediate cutting
g. Pruning
h. Reforestation
i. Reproduction
j. Rotation
k. Sapling
l. Seedling
m. Selection
n. Silviculture
o. Stand
p. Stand density
q. Timber Stand Improvement
r. Uneven-aged

OBJECTIVE 2

Choose the best word or phrase to complete statements about the purpose and scope of forest management. Circle the correct answers. Items may have more than one correct answer.

1. With information from the cruise and knowledge of environmental factors, the forest manager can ______ .

   a. develop the management plan

   b. estimate the costs and profits

   c. advise the landowner

2. For each stand, the forest manager develops a plan according to ______ .

   a. a formula for the basic types of forest stands

   b. the landowner's objectives and goals

   c. projected expenses, profits and risks

3. The forest manager manipulates the development and maintenance of forest crops to produce the ______ .

   a. greatest profit in the shortest time

   b. ideal objectives of the management plan

   c. desired product in the shortest time possible

4. Forest management is considered an ongoing process because of ______ .

   a. changes in industry and environmental factors

   b. the length of time involved in growing a forest crop

   c. turnover of employees

5. Best Management Practices (BMP) program in which foresters, landowners, and logging contractors do what is good for the environment is _____ .

   a. voluntary

   b. required by the USDA

   c. required by the Environmental Protection Agency

OBJECTIVE 3 **List responsibilities of the forest manager.** List six responsibilities.

____

____

____

____

____

____

____

____

____

____

____

____

____

OBJECTIVE 4

Define practices of forest management.

1. Silviculture

____

____

____

2. Reproduction

____

____

____

3. Creating a new stand

____

____

____

4. Harvest cutting and stand renewal

____

____

____

OBJECTIVE 5

List advantages and disadvantages of natural and artificial methods of reforestation. Write two advantages and two disadvantages for natural and artificial methods of reforestation.

Natural methods

Advantages

____

____

Disadvantages

____

____

Artificial methods

Advantages

____

____

Disadvatanges

____

____

OBJECTIVE 6

Choose the best word or phrase to complete statements about seeding and planting methods. Circle the correct answer or answers.

1. In strip and spot seeding, seeds are _____ .
   a. placed by machine or by hand
   b. allowed to remain on top of the ground
   c. sometimes applied by aerial application
   d. covered by soil
2. The advantage of a compression method of planting is that it is _____ .
   a. easy to cover the roots completely with soil
   b. easy to plant in difficult soils
   c. fast
   d. clean
3. In broadcast seeding, seeds are _____ .
   a. placed in pre-drilled holes
   b. germinated before seeding occurs
   c. allowed to remain on top of the soil
   d. applied by aerial or ground application

4. Compared to planting, seeding _____ .

   a. is more expensive

   b. can result in heavier losses

   c. requires fewer thinnings

   d. is less labor-intensive

5. The advantages of planting seedlings are _____ .

   a. a healthier start

   b. faster planting

   c. more controlled density

   d. better genetic characteristics

6. One of the most common causes of seedling failure is _____ .

   a. insufficient water

   b. improper planting

   c. poor stock

   d. poor soil

OBJECTIVE 7

Select from a list true statements about the types of seedlings. Write an "X" in the blank before each true statement.

____ 1. Cuttings are not actually seedlings, but small branches of the tree.

____ 2. Bareroot seedlings are inexpensive, but difficult to plant.

____ 3. Cuttings and containerized seedlings are equally easy to transplant.

____ 4. Cuttings are easy to make, store, ship, and plant.

____ 5. Containerized seedlings grow much taller than bareroot seedlings.

____ 6. Bareroot seedlings include only the stem and roots.

____ 7. The roots of containerized seedlings are protected, but the seedlings are more expensive and more difficult to transport than bareroot.

____ 8. Cuttings and containerized seedlings are available for all species, but bareroots are not.

____ 9. All three types of seedlings have some kind of root, stem, and leaf arrangement.

___ 10. Cuttings may require the application of a root promoting agent.

___ 11. Cuttings cannot be used with all species.

___ 12. All three types are raised in a greenhouse and can be grown in environments similar to their planting environments.

OBJECTIVE 8

State the purposes of intermediate cutting in forest management.

____

____

____

____

____

____

____

____

OBJECTIVE 9

Determine the type of intermediate cut. Write the type of intermediate cut being performed in the following descriptions. Use the following words for your answers:

Precommercial—pre,

post/pulpwood—p/p,

release—rel,

improvement—imp,

salvage—sal.

________________ 1. A young stand is growing beneath several very old, large trees. The old trees are removed.

________________ 2. A stand has not been cut in the past. It is full of unmarketable trees. Some are crooked, some forked, some dead. The undesirable trees are removed.

_______________ 3. A stand of saplings has never been cut. During the first cut, saplings which are poorly formed or defective are removed.

_______________ 4. A stand of immature trees is growing more slowly than desired due to competition for sunlight and nutrients. Less desirable trees are removed to lower the stand density.

_______________ 5. A stand of saplings must compete with undergrowth and a competing species. Undesireable trees of about the same age are removed to reduce competition to the desirable species.

_______________ 6. Bark beetles have infested the southeastern corner of a stand of loblolly pine. The whole southeastern corner and another 8 acres are cut and sold.

_______________ 7. Smaller products are taken out of a fully stocked immature stand. The less valuable trees are removed and sold to provide the first income from the stand.

OBJECTIVE 10

Choose the best word or phrase to complete statements about types of harvest cutting. Circle the correct answers.

1. An even-aged management system where most trees are removed but several good seed producers are left to regenerate the forest is called ______ .
   a. shelterwood cutting
   b. seed tree cutting
   c. release cutting
2. If harvesting involves removing only individual trees which have reached a certain size, management system being used is ______ .
   a. scientific management system
   b. even-aged system
   c. individual tree selection

3. About half of the trees in a stand were removed and younger trees planted. The younger trees are now established and the remaining older trees are to be harvested. This type of cutting is ______ .

   a. shelterwood cutting

   b. even-aged system

   c. uneven-aged system

4. A small section of a stand being grown under an uneven-aged management system was harvested allowing sunlight into the stand to benefit young trees and saplings. This type of harvest cutting is ______ .

   a. section cutting

   b. group selection

   c. thinning

5. After harvesting, this site will have to be completely reforested. This type of harvest cutting is ______ .

   a. clearcutting

   b. group selection

   c. release cutting

OBJECTIVE 11

State advantages of harvest cutting systems. Write one advantage for each of the harvest cutting systems listed below.

Clearcutting ______________________________

____

Shelterwood ______________________________

____

Seed tree cutting ______________________________

____

Group selection ______________________________

____

Individual tree selection ______________________________

____

NOTICE	The following assignment sheet and job sheet are not part of the written test. If they have not been completed, check with your instructor.	
OBJECTIVE 12	**Write a report on clearcutting.**	SCORE ________
OBJECTIVE 13	**Demonstrate the ability to plant bareroot seedlings.**	RATING _______

WRITTEN TEST ANSWERS

APPLY FOREST MANAGEMENT PRACTICES

XIII

OBJECTIVE 1

1. h
2. o
3. l
4. a
5. d
6. m
7. c
8. b
9. q
10. e

OBJECTIVE 2

1. b
2. b
3. b, c
4. a, b
5. a

OBJECTIVE 3

Answer should include any six of the following:

- Helps landowners determine goals according to the landowner's objectives and characteristics of the stand.
- Develops a management plan to achieve the goals.
- Oversees the planting, growth and maintenance, and harvesting of the timber crop.
- Monitors the density of the stand, thinning as needed.
- Prescribes long-range harvesting, thinning, and planting plans.
- Determines the rotation, species, and management system used.
- Protects the crop from dangers such as fire, infection, and wildlife damage.
- Adapts the plan to provide alternatives as conditions change.
- Monitors the site, including the soil, climate, and non-crop growth.

OBJECTIVE 4

1. The theory and practice of controlling forest establishment, composition and growth. Silviculture deals basically with the growing, shaping, and maintenance of tree stands.
2. The process by which a forest or range is renewed. The two basic methods are artificial and natural.
3. The process of growing a stand of trees where one did not exist before.
4. Harvesting is removing trees from a stand to process and market the wood. Stand renewal is seeding or planting the next generation of trees or the steps taken to insure natural reproduction.

OBJECTIVE 5

Answers should include two from each category.

Natural methods—Those found in nature.

- **Advantages of natural methods**
  - Inexpensive
  - On-going
  - Offers more variety
- **Disadvantages of natural methods**
  - Poor stand development (density, poor parent stock)
  - Poor seed placement
  - Unreliable, inconsistent results

Artificial methods—Those provided by man.

- **Advantages of artificial methods**
  - Greater ability to control the quality of the stand
  - Ability to reforest quickly
  - Ability to create a new stand
  - Ability to change stand compositions
- **Disadvantages of artificial methods**
  - Expense
  - Labor intensive

OBJECTIVE 6

1. a, d
2. c
3. c, d
4. b, d
5. a, c
6. b

OBJECTIVE 7

1, 4, 6, 7, 10, 11

OBJECTIVE 8

- To improve the existing stand by removing defective or undesirable trees.
- To improve the existing stand by reducing stand density.
- To protect the stand by removing trees infected by insects or disease.
- To realize an early profit from the sale of removed trees.

OBJECTIVE 9

1. Release
2. Improvement
3. Precommercial
4. Post/pulpwood
5. Precommercial
6. Salvage cut
7. Post/pulpwood

OBJECTIVE 10

1. b
2. c
3. a
4. b
5. a

OBJECTIVE 11

Answer should include one from each harvest cutting system

- Clearcutting
  - Allows maximum sunlight for new stand
  - Allows reforestation with a more desirable species
  - Allows greatest control of next crop placement
  - Provides fast growth of new crop
  - Least expensive harvesting process
- **Shelterwood cutting**
  - Allows protection for new crop
  - May be more aesthetically pleasing than total clearcutting
- **Seed tree cutting**
  - Allows continuation of proven stock
  - Allows natural seeding on clearcut land
- **Group selection**
  - Provides sunlight for young plants while maintaining the stand
  - Less expensive than individual tree selection
- **Individual tree selection**
  - Allows each tree to reach its potential
  - Provides aesthetically pleasing forest recreation areas in addition to a cash crop

OBJECTIVE 12

Refer to Answers to Assignment Sheet 1.

OBJECTIVE 13

Refer to Practical Test Rating for Job Sheet 1.

OBJECTIVE SHEET

IDENTIFY FOREST FIRE PROTECTION PRACTICES

XIV

INTRODUCTION

Wildfires have aroused intense fear and caused untold damage since earliest times. It is only in the last century that we have records showing the amount of damage to life and property caused by wildfires.

In the 1980s there were over 73,000 forest fires in the United States. The fire suppression efforts of 41,000 fire fighters prevented all but 299 from becoming major fires.

UNIT OBJECTIVE

After completing this unit, the student should be able to identify the types, causes, and effects of wildfires and prescribed fires, and the tools and techniques of fire fighting. The student will demonstrate these competencies by completing the assignment sheets and written test with a minimum of 85 percent accuracy.

PREREQUISITES

None

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with forest fire protection practices to their correct definitions.
2. Select from a list true statements concerning wildfires.
3. Match causes of wildfires to their descriptions.
4. List effects of wildfires.
5. Select from a list true statements concerning prescribed burning.
6. Choose the best word or phrase to complete statements about the Fire Triangle.
7. Label parts of a forest fire.
8. Name the types of forest fires, given a newspaper description.
9. Choose the best word or phrase to complete statements about factors influencing fire behavior.
10. Distinguish between direct and indirect methods of attacking a fire.
11. Match fire-fighting tools to their uses.

12. Choose the best word or phrase to complete statements about fire control.
13. Observe a fire scene. (Assignment Sheet 1)
14. Interview forest fire fighters. (Assignment Sheet 2)
15. Analyze information on forest fires. (Assignment Sheet 3)

IDENTIFY FOREST FIRE PROTECTION PRACTICES

PREPARATION

- Obtain materials to supplement unit.

  NOTE: See Suggested Resources.

- Review instructional outline for this unit. Modify time frames to suit class needs and plan activities for each class period.

- Study the specific objectives to determine those you will cover in your presentation. Decide which objectives should be taught to which students.

- Determine scope and sequence of objectives that you add. Design and develop support materials, including evaluation techniques, for additional objectives.

- Determine how you will schedule time for students to demonstrate competence in the required procedures.

- Locate a forest fire site and arrange for students to visit it.

- Contact your District Forester and request photos, films or videotapes of forest fires.

- Contact your nearest television network affiliate and request video footage of forest fires.

- Collect information on forest fires in your immediate area from the State Forestry Department, the Bureau of Land Management or an office of the U.S. Forest Service. Find out about the numbers, causes, effects and costs of prescribed fires and wildfires. Use as a supplement to Assignment Sheet 3.

- Invite foresters to discuss forest fires, their history, prescribed fires and wildfires, fire detection, suppression and mop-up.

- Invite a soil conservationist or agricultural extension agent to discuss the effects of forest fire on erosion and water supply.

- Invite a fire fighter or Fire Department Public Education Officer to discuss the Fire Triangle with the class.

  NOTE: Supply guest speakers with specific objectives and other appropiate sections of the unit.

DELIVERY

Objective 1

- Share personal stories from your experience or from other people's experiences about forest fires.
- Have students collect newspaper and magazine pictures and articles about forest fires in the state, region, nation, continent, or abroad.
- Review terms with students.
- Show the video *Wildfire Strikes Home!*

Objective 2

- Show the video *Yellowstone Fire.*
- Refer students to Supplement 1.
- Show photographs, videos or magazine photos of forest fires.

Objective 3

- Assign students to research statistics or give them the data you have collected on the causes of fires in your area for the past several years.
- Have students review the conditions and causes of fires listed in Supplement 2.
- Demonstrate, in a carefully controlled situation, how easily forest fires can start, using a cigarette butt or single match on dry grass.

  WARNING: Check with school officials before conducting this or other exercises using open flames and have an operable fire extinguisher available.

Objective 4

- Have students complete Assignment Sheet 1.
- Have a soil conservationist or agricultural extension agent discuss the effects of forest fire on erosion and water supply.

Objective 5

- Discuss how burning available fuel is used as a fire prevention technique.
- Check the list of causes of fires in Supplement 2 for the number of prescribed burns.
- Have a forester discuss prescribed burning with students.
- Stress that prescribed burning requires specific conditions and experienced supervision. Prescription burning should be done only by trained and experienced individuals.

Objective 6

- Have a fire fighter or Fire Department Public Education Officer discuss the Fire Triangle with the class.
- Build protected campfire-size fires in a safe location and let students observe and participate in breaking the Fire Triangle with water, dirt, wet sacks, scattering fuel, etc. Let them time the effects of various techniques.

Objectives 7 through 9

- Have students share the information gathered from magazines and newspapers to determine the type of fire in each article.
- Refer students to Supplement 2 to review types of fires and conditions at the time of the fires.
- In a carefully controlled situation, such as in a sand pile, build a fire to simulate a forest fire, using toothpicks, ice cream sticks, twigs, shredded paper or grass clippings as different weights and arrangements of fuel. Place "stands" of fuel with high and low moisture content. Include sand piles or rocks arranged with fuel to demonstrate topographic factors. Let students watch the fire spread through different moisture levels, arrangements and weights of fuel, grass, etc., and describe the fire's shape and behavior. Add "winds." Have a water hose, dirt and rakes ready to extinguish the fire.

Objectives 10 through 12

- Divide students into groups and have them complete Activity Sheet 1. Allow class time for presentations of each group's scenario.

- Have a forest fire fighter discuss fire detection, direct and indirect suppression and mopping-up and patrol.
- Have students complete Assignment Sheet 2.
- If equipment is available to you, give students the opportunity to practice using a council rake, shovel, backpack sprayer and swatter.
- Refer students to Supplement 3 for a look at a new area of concern to forest fire fighters.
- Have students complete Assignment Sheet 3.
- Display students' tables and graphs.

APPLICATION

Objective 13

- Use Assignment Sheet 1 to give students direct, sensory experiences of the effects of a forest fire and to give them practice in observing and recording their observations.

Objective 14

- Use Assignment Sheet 2 to give students opportunities to practice gathering information by interviewing and to make fighting a forest fire a more concrete experience.

Objective 15

- Contact a staff forester from your state forestry division. In Oklahoma contact: State Department of Agriculture, Forestry Division, 2800 N. Lincoln, Oklahoma City, OK 73105-4298, (405) 521-3864.
- Use Assignment Sheet 3 to give students an appreciation for the relationships among fire conditions, causes and costs. This assignment sheet also gives students practical math application and practice in graphic representation of statistics.

EVALUATION

Written test

- Explain to students that they will be asked to demonstrate on the written test actions listed in the specific objectives.
- Give written test.

  NOTE: The written test may be given in sections if desired.

- Evaluate students on assignment sheet activities if not previously done.
- Reteach and retest if necessary.
- Complete appropriate section of competency profiles.
- Review individual and group performance in order to evaluate teaching methods. Adjust scope, sequence, or instructional approaches for additional lessons as required.

SUGGESTED RESOURCES

Publications

- *Need to Burn Debris? Burn Within the Law*, OSU Extension Facts Sheet No. 5019. Available from Central Mailing Services, Oklahoma State University, Stillwater, OK 74078.
- *Oklahoma Forestry Code*. Available from Forestry Division, 2800 N. Lincoln Blvd., Oklahoma City, OK 73105-4298. Includes laws and regulations on burning and wildfires.
- Moore, John L., "Firestorm! (Trapped in a Yellowstone Fire)," *Reader's Digest*, Vol. 134, March 1989.
- Abbey, Edward, *Fire on the Mountain*, Avon Books, New York, 1982. Well-written, entertaining essays on living in a lookout tower, fire fighting, ecology, and nature.

Speakers

Oklahoma Natural Resources Speakers Bureau sponsored through Oklahoma State University, Division of Agriculture, Oklahoma Cooperative Extension Service - Forestry, Oklahoma Conservation Commission and the Oklahoma Forestry Association. Lists speakers on a variety of forestry-related topics. Speakers operate on a time-available basis. Request a listing of speakers, programs, slide presentations and videotapes from your local extension office or from:

Dr. Steve Anderson
Forestry Dept.
Oklahoma State University
239 Agricultural Hall
Stillwater, OK 74078
(405) 744-9431

Dave Marcouiller
Forestry Dept.
Oklahoma State University
242 Agricultural Hall
Stillwater, OK 74078
(405) 744-5444

Teachers from outside of Oklahoma should contact the Forestry Extension Office in their state.

Audiovisual Materials

- *Wildfire Strikes Home!*, Videotape, Part 1: 14 min, Part 2: 15 min, Part 3: 23 min, 1987, National Fire Protection Association, U.S. Forest Service and U.S. Fire Administration. Part 1 shows fire fighting in California; reviews the history of three major wildland-urban interface fires; and reviews Black Friday, a fire in Florida. Part 2 reviews the problems with interface areas and fires. Part 3 reviews what's being done about interface fires.

  NOTE: This video is available from OSU Agricultural Information Library, Oklahoma State University, Stillwater, Oklahoma, 74078, (405) 744-6886.

  Supplemental materials available: Viewer's guide, facilitator's guide, *Wildfire Strikes Home!* book, a self-help for Solving Fire Problems publication, and *Wildfire Strikes Home!* sample newsletter.

- *Yellowstone Fire*, video, 21 min., National Park Service. Shows firefighters using tools to fight Yellowstone fire. Features interviews with firefighters.

  NOTE: This video is available to Oklahoma teachers on a free-loan basis from the Oklahoma Department of Vocational and Technical Education, Resource Center, ATTN: Instructional Media Specialist, 1500 W. Seventh Avenue, Stillwater, OK 74074.

The following materials are available on a free-loan basis from the Forestry Extension Program at Oklahoma State University, 242 Agricultural Hall, Stillwater, OK 74078, (405) 744-5444.

- *Prescribed Burning: More than Striking a Match*, 10:30 min, 67 slides and cassette. Discusses the use of controlled burning as a management tool on grasslands. Describes the purposes and benefits of burning and the planning, manpower and tools used in prescribed burning.

- *Prescribed Burning and Wildlife*, 14 min, VHS, U.S. Forest Service. Excellent overview of research on the effects of prescribed burning on wildlife habitat.

- *Wildfire '87 Decision Point for the Future*, 21:37 min, VHS, National Fire Protection Association. Discusses wildfire during the 1985-86 fire seasons and problems facing the wildland/urban interface.

UNIT REFERENCES

- Anderson, David A. and I. I. Holland, *Forests and Forestry*, The Interstate Printers & Publishers, Inc., Danville, Illinois, 1982.

- Collins, B. McManus, and Fred M. White, *Elementary Forestry*, Reston Publishing Company, Reston, Virginia, 1981.

- *Forestry Aide Curriculum for Native Americans*, Arizona Center for Vocational Education, Flagstaff, Arizona, 1984.

- *Harvesting Forestry Products*, Texas A & M University, College Station, Texas, 1976.

- *Introduction to the Fundamentals of Fire Behavior*, Forest Service, U.S. Department of Agriculture, TT-9-(5100), n.d.

- Stoddard, Charles H. and Glenn M. Stoddard, *Essentials of Forestry Practice*, 4th ed., John Wiley & Sons, New York, 1987.

INFORMATION SHEET

IDENTIFY FOREST FIRE PROTECTION PRACTICES

XIV

OBJECTIVE 1

Match terms associated with forest fire protection practices to their correct definitions.

- **Aerial fuels**—All burnable vegetation above six feet from the ground
- **Backfire**—Setting a line of fire in front of the main fire; it burns against the wind, robbing the main fire of fuel
- **Canyon**—A deep valley with high, steep slopes
- **Detection**—To discover the presence or existence of a fire
- **Duff**—Forest litter and other organic debris in various stages of decomposition on the forest floor
- **Erosion**—Soil lost because water carries it downhill into valleys, streams, rivers, and lakes
- **Fire behavior**—Intensity, speed, spread, temperature, and height of burning
- **Fire control**—Containing the fire within a certain perimeter
- **Fire hazard**—A condition that can start or feed a fire
- **Fire lane or fire break**—A barrier, either already existing or built before a fire occurs or spreads, used to stop or check fires
- **Fire line**—The front edge of an advancing fire
- **Incendiarism (in-SEN-dee-ar-ism)**—The intentional destruction of property by fire
- **Mineral soil**—Bare soil, containing nothing that will burn
- **Spot fire**—Started when sparks from the main fire ignite a new fire

  NOTE: Sparks can fly as much as half a mile in front of the main fire.
- **Suppression**—All the work of extinguishing a fire
- **Wildfire**—Uncontrolled forest fires

OBJECTIVE 2

Select from a list true statements concerning wildfires. (Supplement 1)

Worst fires

- **The Miramichi Fire**—Started on October 7, 1825, after a long dry period. It burned 9 hours, fed by gusty winds and millions of coniferous trees. It covered an area 80 miles (130 km) long and 25 miles (40 km) wide, over 1.3 million acres. Many buildings were destroyed and 160 people died.

- **The Peshtigo Fire**—On October 8, 1871, after a long drought, railroad workers were burning slash when high winds came up, driving the fire out of control. Four million acres were burned in Wisconsin and Michigan; the fire took 1,500 lives. In terms of human suffering, this was the worst wildfire in U.S. history.

  NOTE: The fire built up enough intensity that by the time it reached the logging village of Peshtigo, the houses exploded from the heat; new ax heads in a crate melted and fused together. People who jumped into the river to escape the flames said the surface was so hot it was nearly boiling. The Peshtigo Fire is not "famous" because it happened on the same day as the famous Chicago Fire that caused 200 deaths. Telegraph lines from Peshtigo were burned and it was more than a month before word of the forest fire reached the rest of the country. By then it was "old news."

Fire Fighters Must Work Hard To Contain Forest Fires

Courtesy of USDA, Forest Service.

- **The Yellowstone Fire**—Started by lightning at Shoshone Lake on June 23, 1988 and burned almost four months in a record drought season. The moisture level of the fuel was 2% (The moisture level of a match stick is 7-9%.) The park had a "let-burn" policy, meaning that fires that started naturally were allowed to burn in order to support natural ecological changes.

  Fire fighters were gaining control until August 19th when winds 40-60 mph, and gusting to 80 mph, hit the fire.

  More than 10,000 fire fighters worked the Yellowstone Fire. The loss was 1.38 million acres, billions of dollars worth of timber and homes, and over $120 million in damage to the Yellowstone National Park. Tourist trade fell 30%. The bill for suppressing the fire exceeded $600 million.

  The loss of human life and wildlife was surprisingly low for a fire of this size, intensity and duration.

Fighting A Forest Fire Is Demanding And Often Exhausting For Fire Fighters

Courtesy of USDA, Forest Service.

970

NOTE: When the winds came on August 19, a smaller fire, Hellroaring, exploded from 8,000 to 22,000 acres, burning 165,000 acres in 24 hours. Hellroaring was only 1 of 12 raging fires that shot flames 200 feet high, forming a column of smoke that stretched 40,000 feet up.

By mid-September, 50 fires had been suppressed, and 9 still burned. On September 14, the fire flared again, burning 56,000 acres in 6 hours and boiling up clouds that reached clear to Denver, Colorado, 400 miles away. Finally on September 20 light rain brought the fire under control, but it was not suppressed until late October when the first good snows fell on Yellowstone.

The Devastation Of The Yellowstone Fires Left Some Areas Almost Barren

Courtesy of USDA, Forest Service.

Blowup fires

- High-intensity fires such as these are called "blowup" fires. With plenty of fuel and strong winds, they suddenly intensify and spread with such speed that no control is possible. The blowup happens so fast that at the center of the fire, whirling winds can become as violent as cyclones. Powerful updrafts can lift burning materials 5,000 feet in the air and drop them far ahead of the blaze, starting spot fires that will dry and heat still more fuel.

- Most wildfires are not blowup fires, but they are still very dangerous, destroying millions of acres, homes, wildlife, domestic livestock, water supplies and human life. To control the fire requires an enormous fire fighting effort, costing millions of dollars, and human health and lives.

OBJECTIVE 3

Match causes of wildfires to their descriptions.
(Supplement 2)

NOTE: The percentages in this objective stand for the percent of all fires in U.S. protected forest and watershed lands. Notice how many of these fires are caused by people and, therefore, can be prevented. The best prevention is education, as in the Smokey the Bear campaign, started in 1944. The second-best prevention is serious legislation to encourage safety and to penalize careless or malicious offenders.

- **Incendiary**—(26%) Fires are set intentionally, some under the mistaken belief that burning the underbrush will kill ticks and other insects, and some set deliberately and maliciously to burn the forest

- **Burning debris**—(23%) Fires started, usually by landowners, to burn trash, get rid of brush, or to clear land, get out of hand and spread to nearby forested areas

  NOTE: Burning debris is not a wise practice because burning destroys much organic matter that might have been returned to the soil. Some states, but not enough, require burning permits, and others encourage safe burning practices.

- **Careless smokers**—(17%) Fires are caused by automobile drivers, hikers, campers, hunters, fishermen, and woods workers tossing cigarette butts or matches in the forest

  NOTE: Many states now have laws against throwing burning materials from cars. The best prevention is to teach people to be aware of the danger of forest fires and to use caution when smoking.

Fires, Such As This One, Are Often Caused By Human Carelessness

Courtesy of USDA, Forest Service.

- **Lightning**—(9%) Occurring mainly in the West; the only important natural and unpreventable cause of fires

- **Machinery**—(7%) Sparks from engine fires, exhaust, electrical and other problems from operating equipment, and tools using gasoline or fuel oil

  EXAMPLES: Trucks, cars, motorcycles and trail bikes, chainsaws, dozers, skidders, tractors

- **Railroad operations**—(5%) Reduced numbers of fires in recent years due to improved spark arresters and the conversion to electric and diesel equipment

- **Campers and picnickers**—(3%) Building fires in unsafe places or abandoning still-burning campfires

  NOTE: Simply teaching campers to douse fires completely with water before leaving the area would reduce the number of camper-caused fires.

- **Miscellaneous causes**—(10%) Most are caused by human carelessness or error and could have been prevented

OBJECTIVE 4

List effects of wildfires. (Assignment Sheet 1)

NOTE: The damage created by a wildfire depends on a number of factors: the size, intensity, and duration of the fire; the size and composition of the timber stand; the nature of the fuel burned; the frequency of fire on the area; and the character of the soil.

Harmful Effects

- Loss of merchantable lumber

- Loss of all timber in very hot fires

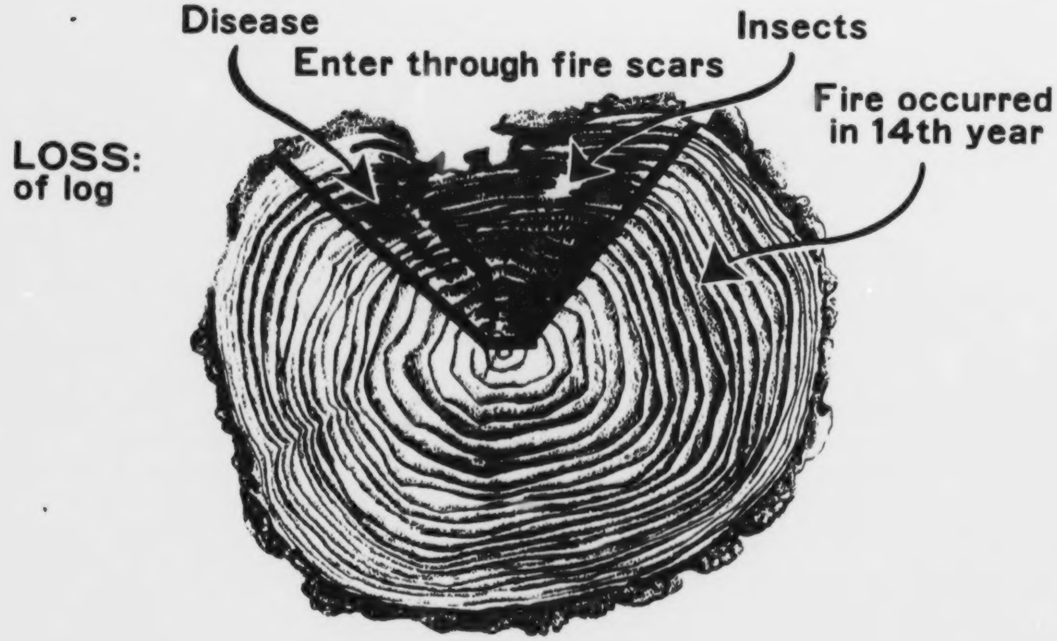
- Loss of young trees that would provide future forests

  NOTE: Trees that survive the fire may grow more slowly than normal because the green foliage is lost.

- Scarring of tree trunks causes decay and produces marred lumber, with reduced volume and reduced value

  NOTE: Scarring is permanent.

- Fire-scarred trees are open to insect attack and diseases and are more easily blown over by winds



How Fire Ruins Timber

Wood destroying rot and insects entered through the fire scar. The defect in the tree is permanent. The more intense fires also kill some trees outright, and slow down the growth of others by killing part of the green foliage.

Courtesy of Instructional Materials Service, Texas A & M University, College Station, Texas.

- Loss of plant and animal life

  NOTE: Fire destroys forage, so that even if large animals survive the fire, they can starve in the winter months. Most animals die from smoke inhalation. In addition, wood ashes are washed into streams, killing fish. Destruction of vegetation along streams and rivers can raise the water temperature, making it unfit for trout.

- Soil erosion

  NOTE: Loss of ground cover due to fires can cause erosion which fills reservoirs, stream channels, and harbors with tons of erosion silt and sediment.

- Damage to the soil

  NOTE: Fire affects the chemical properties of soil and its ability to grow certain types of plants or to sustain plant life.

Forest Fires Damage Not Only Trees And Undergrowth But Also The Soil

Courtesy of USDA, Forest Service.

- Flood damage and water supply problems
- The predominant crop can shift from valuable pines or spruces to the growth of inferior species

- Air pollution

  NOTE: Wood smoke contains large amounts of ash and hydrocarbon products.

- Tourist and recreation businesses lose money

A Fire Fighter Performs Mopping-up Operations After The Colville Fire During The Summer Of 1988 In Washington State

Courtesy of USDA, Forest Service.

Beneficial Effects

- Destroys old and diseased trees
- Promotes the natural ecological cycle of the forest

  NOTE: With old trees gone, sunlight can reach the forest floor and new trees can grow, along with grasses and plants.

- Creates a new type of wildlife habitat and renews the habitat for deer, turkey and other animals

OBJECTIVE 5

Select from a list true statements concerning prescribed burning.

NOTE: Most people think of the destruction caused by forest fires without realizing that there are benefits as well. Forest fires in the past produced heat resistant species, conifers with thick, insulating bark and tolerance to low-intensity fire. Prescribed burning is a standard procedure for forest management and can be an asset in maintaining healthy forests. Although this objective covers the benefits, there are also hazards such as air pollution, soil erosion, water pollution, and the danger of a larger, more destructive fire. Only trained, experienced personnel should handle prescribed fires.

Prescribed (prescription) burning means applying fire to land under very carefully controlled conditions in order to achieve certain management goals.

Prescribed burning is a tool that is relatively inexpensive to use and when used properly, can accomplish more than extensive use of chemicals.

- A fire lane is built around the area to be burned, combining natural barriers with a plowed fire break. When wind, temperature, humidity, and soil moisture conditions are right, a team of foresters carefully sets the fire and it is strictly controlled. **Any fire** can get out of control and cause major destruction.

- There are different techniques for prescription burning. They are used according to the weather and wind conditions and type and amount of fuel available. Prescribed burning can only take place under specific, proper conditions. The determining factors are:

  Soil moisture
  Weather conditions
  Wind direction: from the southwest or north; east winds are not reliable
  Wind velocity: 2 mph min. - 7 mph max.
  Temperature range: 20° F min. - 50° F max.
  Relative humidity range: 30% min. - 50% max.
  Type of fuel: light, medium, heavy, or mixed types

Objectives of prescribed burning

- **Reduce fire hazards**—Burns build-up of fuel from road rights-of-way, recent cuts, and other areas. As a stand ages, litter, grasses, dead twigs, limbs and brush build up. Under proper weather and seasonal conditions, a low-intensity fire can burn that built-up fuel in a pine stand. For many years, any wildfire moving through the area will burn at low intensity, and the stand will be protected from severe damage.
- **Reduce competition for the harvest crop**—Cleans out unwanted vegetation.

  EXAMPLE: Reduce competition of low-quality hardwoods to promote more valuable timber.
- **Prepare seedbed sites**—Burns out logging slash to improve access for planting crews, exposes the mineral soil to help seed germination, and reduces weed competition for seedlings.
- **Control brown spot disease**—Prescribed burning is the standard technique for protecting longleaf pine regeneration.

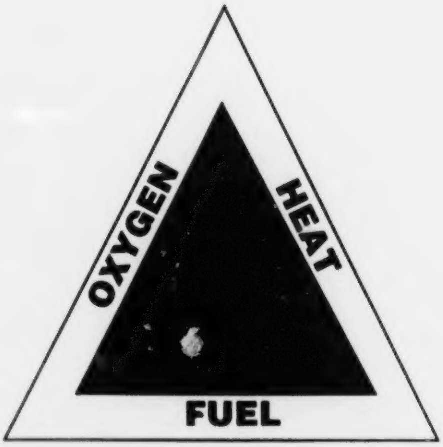
Additional benefits

- Increases grasses, seeds, and browse for wildlife and domestic stock.
- Improves access for recreational use and logging.
- Improves the beauty and appeal of an area.
- Allows regeneration of tree species that would not be able to compete without the benefit of fire.

  EXAMPLE: Lodgepole pine requires high temperatures to burst the cones and release its seed.

OBJECTIVE 6

Choose the best word or phrase to complete statements about the Fire Triangle.

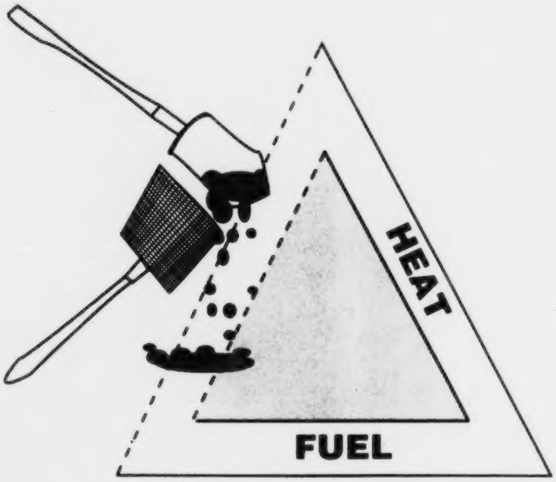


Oxygen + Fuel + Heat = Fire

The Fire Triangle represents the three elements that are needed for fire to burn. Combustion can occur **only** when the Fire Triangle is complete. A fire will stop burning if any part of the Fire Triangle is broken.

OXYGEN—Oxygen is available in the air. The more oxygen the fire has, the faster and hotter it will burn. Wind brings more oxygen to a fire.

Remove the oxygen to break the Fire Triangle—Smother with dirt; swat with swatter tool, limb, wet sack or shovel.

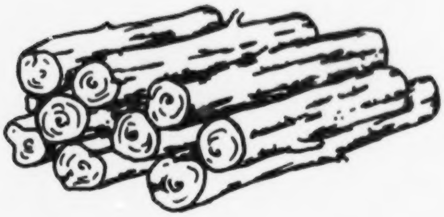


FUEL—Dried grass or leaves, duff, small trees, large trees and limbs, brush and stumps—anything at the fire site that will burn.

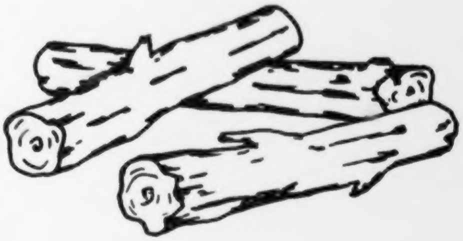
Types of fuel affect how the fire burns. Light fuels such as dry grass and leaves, twigs and brush burn quickly. Heavy fuels such as logs and large limbs burn slowly, producing large amounts of heat as they burn.

Fuel arrangement also affects combustion. If the fuel is tightly arranged, less oxygen will be mixed with it and the fire will burn slower. If the fuel is loosely arranged, more oxygen will be mixed with it and the fire will burn faster.

EXAMPLE: A book or a rolled-up newspaper burns slower than single pages.

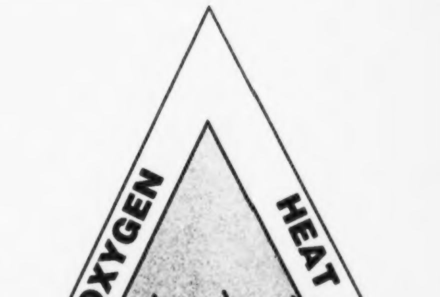


Tightly Arranged



Loosely Arranged

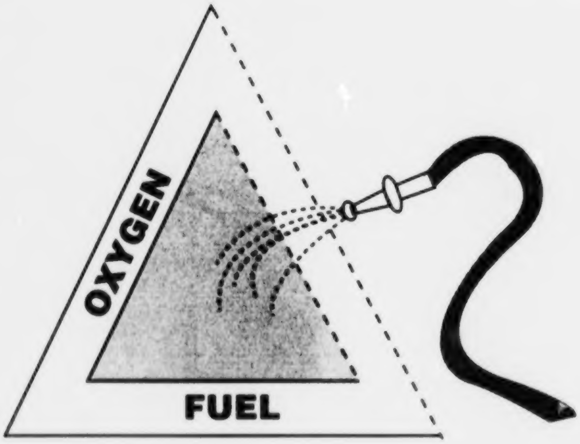
Remove the fuel to break the fire triangle—Clear area with a bulldozer, cut or plow a firebreak, then use a backfire to rob the fire of fuel between it and the firebreak.



HEAT—Comes from the fire itself. If there is plenty of fuel and plenty of oxygen, the fire will continue to burn, producing greater heat with greater amounts of fuel and oxygen. The arrangement of the fuel will affect the amount of heat. The temperature must be high enough to ignite the fuel. For example, light fuels such as dry grasses ignite at a much lower temperature than heavy fuels. Once ignited, heavy fuels burn hotter.

Remove the heat to break the Fire Triangle—Cool the fire with water or chemicals.

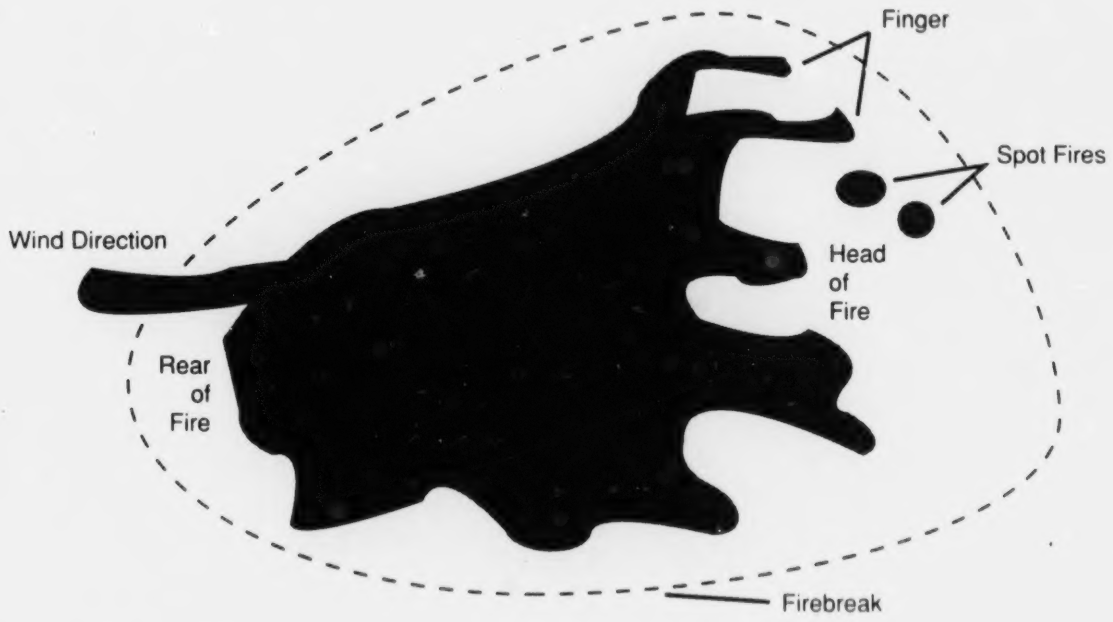
NOTE: Dirt spread to remove the oxygen will also help cool the fire.



Cool With Water Or Chemicals

982

OBJECTIVE 7 | **Label parts of a forest fire.**


Finger
Spot Fires
Wind Direction
Head of Fire
Rear of Fire
Firebreak

Parts of a Forest Fire

OBJECTIVE 8 | **Name the types of forest fires, given a newspaper description.**

- **Surface fires** burn the underbrush and leaf litter on the forest floor, killing small trees and seedlings and damaging many larger trees. The majority of forest fires, especially in the East and South, are surface fires. They are fairly easy to control if attacked promptly, but in dry conditions and high winds, can become highly destructive fires. Almost all forest fires begin as surface fires.

- **Ground fires** burn deep below the surface in thick layers of decayed leaves and needles or in peat layers, killing the roots. They burn slowly and may smolder for weeks or even months, destroying almost all vegetation. Ground fires are common in northern bogs and North and South Carolina in pocosin soils.

  NOTE: Pocosin soils are organic soils found in upland swamps in the southeastern United States. When drained, these soils make good timber sites.

- **Crown fires** occur almost entirely in coniferous forests because their foliage is much more flammable than green leaves of hardwoods. Usually combined with a surface fire, these are the most dangerous and destructive to property and human life. A crown fire starts as a surface fire. Strong winds drive the fire to the treetops, where it sweeps through the timber, jumping by sparks. Crown fires burn faster than surface or ground fires because the **aerial fuel**, wood at treetop level, has more air around it than the fuel at ground level.

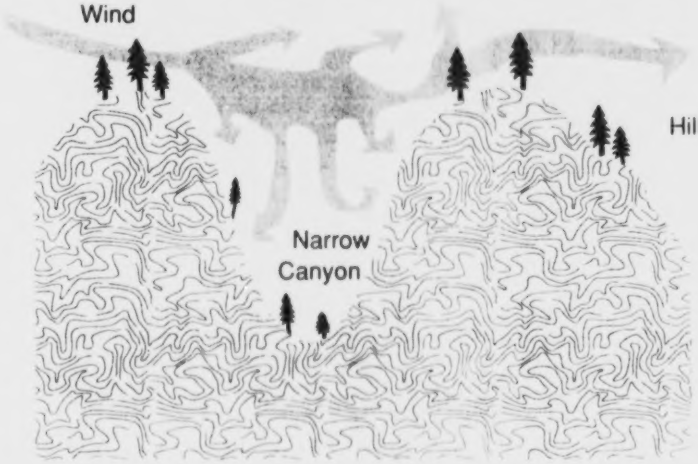
OBJECTIVE 9

Choose the best word or phrase to complete statements about factors influencing fire behavior.

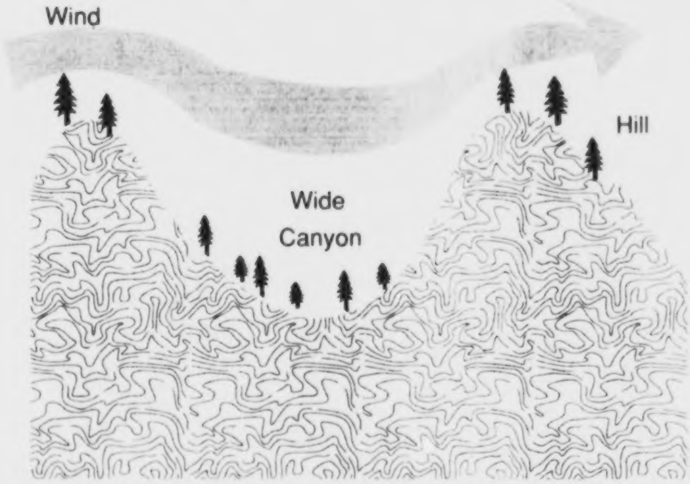
- **Fire season**—Time of extended dry periods and the buildup of fuels. Summer forests in the South are generally green and moist, but in the North and West, summer grasses, brush, and trees, especially narrow-needle conifers, are tinder dry. Fall frosts combined with strong winds dry the vegetation and increase the possibility of fires. Long droughts can create prime fire seasons. Weather conditions, rain, temperature, and relative humidity determine the fire season.

- **Time of day**—Fires are most likely to start and to burn most intensely on sunny days during the middle of the afternoon, when vegetation is driest and the winds are strongest.

- **Air movements**—Horizontal wind movement (east, west, north and south) and vertical wind movement (heat causes air to rise), wind speed, and movement at different levels (ground vs. treetop) govern the duration and the speed of a fire. Updrafts carry sparks up and then horizontal winds move them forward to cause spot fires. Canyons and slopes can create patterns of air movement that intensify the fire.



In This Narrow Canyon, The Wind Causes Turbulent, Or Confused Drafts



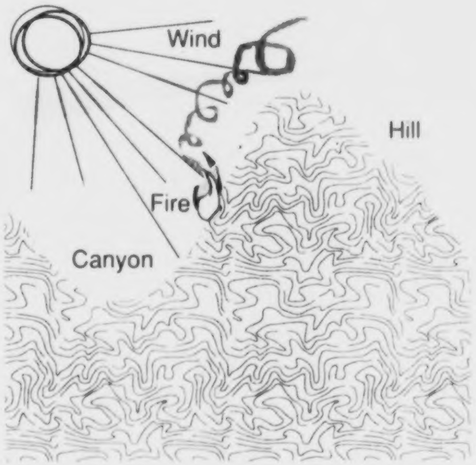
In This Wide Canyon, The Wind Is Steady, Without Violent Up And Down Drafts

Adapted from the United States Forest Service, Department of Agriculture.

- **Humidity**—When humidity is low, fuels will dry and fire spreads more quickly and burns hotter; when there is plenty of rain to keep fuels moist, fire is less likely to occur.

- **Kind, quantity, and moisture content of the forest fuels**—Light ground fuels influence the rate of fire spread. Medium and heavy ground fuels burn more slowly as "smokes," persistent small fires within the large fire. Aerial fuels, except for large limbs and snags, burn quickly, drawing air upward, and contribute to a rapid spread. The amount of fuel influences the intensity of a fire more than the rate. Forest fuel ignites at 600° to 880° F. If fuel has high moisture content, more heat is needed because the water has to evaporate before the fuel will burn. Once the fire is burning at high temperatures, it dries the fuel ahead of it, increasing the fire's intensity as well as the rate.

- **Topography**—Direction of slope, degree of slope, and surface conditions affect the speed with which a fire spreads. Southwestern slopes are the most dangerous. They get the most sun and wind, so they have the driest fuel. In steep terrain, heat and smoke will rise, drying and heating the fuel before the fire reaches it. Oxygen feeds the fires from below, raising the temperature. The fuel comes in contact with the flames more quickly and updrafts drive the fire even faster up the slope.



Adapted from the United States Forest Service, Department of Agriculture.

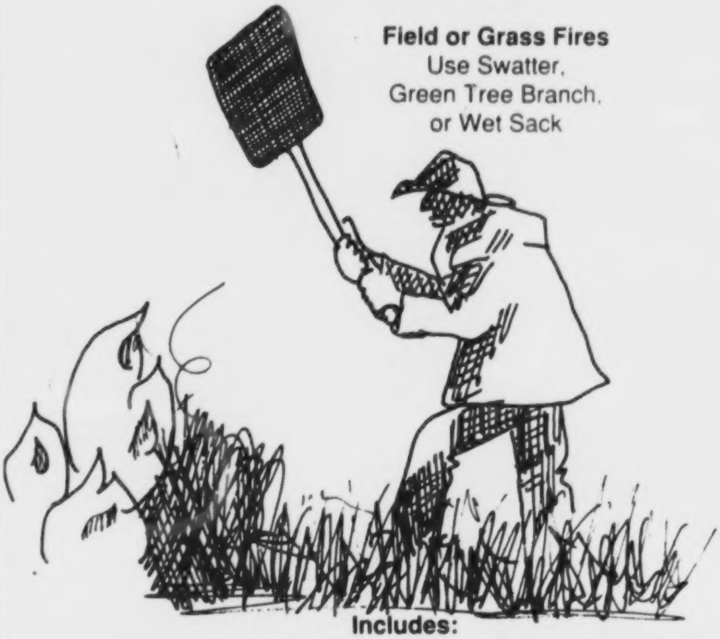
NOTE: Fire burns fastest uphill. On a steep slope, it burns 16 times faster uphill than downhill.

OBJECTIVE 10

Distinguish between direct and indirect methods of attacking a fire. (Activity Sheet 1)

- **Direct attack**—Working directly on the burning edge of the fire; used on small, slow-burning fires without too much heat. Fire fighters swat the fire or smother it with water or chemicals, use rakes and shovels to clear the ground to mineral soil, and throw dirt onto the fire.

Direct Fire Fighting

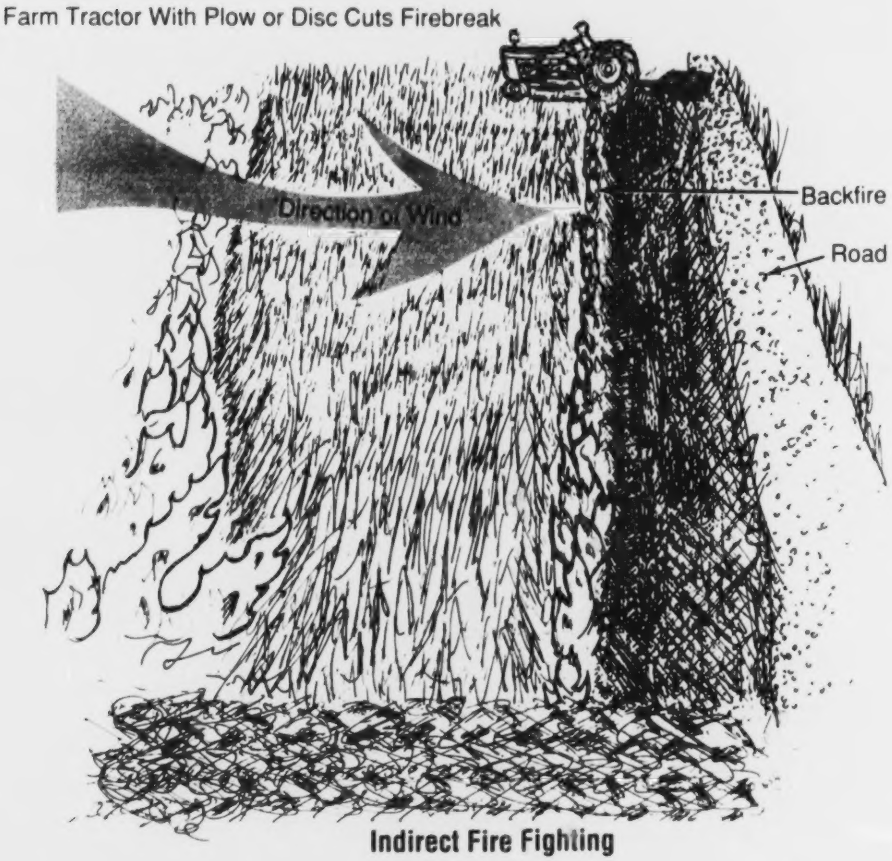


Field or Grass Fires
Use Swatter,
Green Tree Branch,
or Wet Sack

Includes:
Swatting, Watering, and
Smothering at the Burning Edge

- **Indirect attack**—Working back from the burning edge on hot, fast-burning fires. Fire fighters use natural barriers such as roads, streams, and cultivated fields and build fire breaks as needed. They may dig trenches, plow areas around the fire, or use dozers to clear adjoining land. Backfires are used to rob the fuel supply from the main fire. Airplanes spray chemical fire retardant on the leading edge.

  NOTE: Sometimes both direct and indirect methods are used on a single fire. The indirect attack takes place at the fast-moving head and the direct attack on the sides.


Farm Tractor With Plow or Disc Cuts Firebreak
Direction of Wind
Backfire
Road

Indirect Fire Fighting

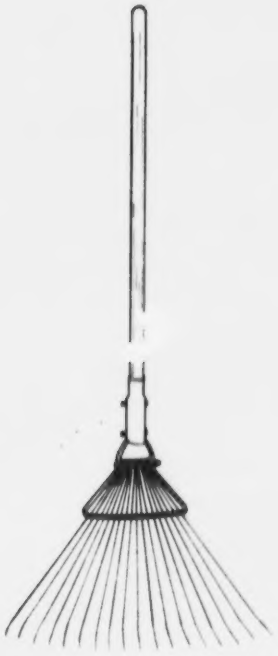
OBJECTIVE 11

Match fire-fighting tools to their uses.

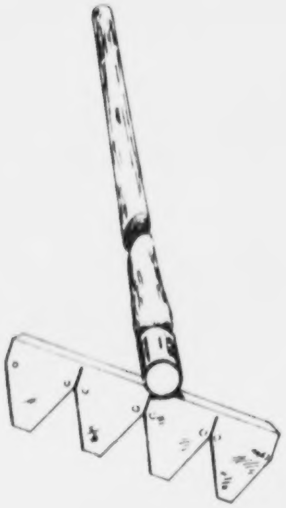
NOTE: In addition to the hand tools below, fire fighters use heavy equipment such as trucks, dozers, and tractors. Airplanes and helicopters are used for detection, to carry water for spraying and chemical materials to bomb fires, and to transfer personnel and light equipment to spot fires before they could be reached by ground crews. Helicopters can carry a large drip torch to drop a fire and ignite the backfire line. All planes and helicopters are equipped with radios and can direct crews to better fire-fighting positions.

- **Rakes**—Remove leaves and twigs to clear fire break

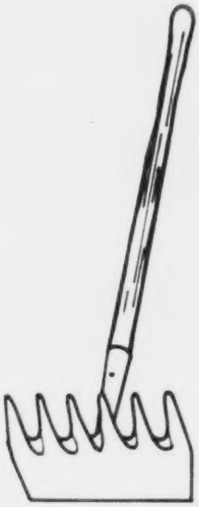
  NOTE: Rakes and swatters are the most commonly-used tools in southern deciduous forests. Council rakes have steel cutting teeth. The McLeod is usually supplemented with a Pulaski or fire rake in rocky or bushy terrain.



Firebroom rake
for clearing light litter



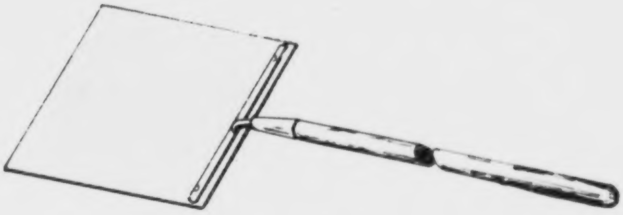
Council rake
for digging; cutting grass, small brush or saplings; rolling burning logs



McLeod rake/hoe
for clearing matted leaves and loose debris

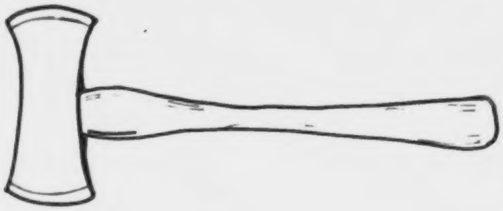
- **Swatter**—Used to put out grass fires

  NOTE: A swatter is also called a flap or flapper.

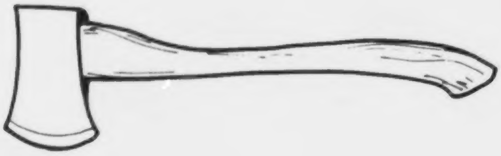


Swatter, flap or flapper

- **Axes**—Clear out brush, trees, snags, and other materials



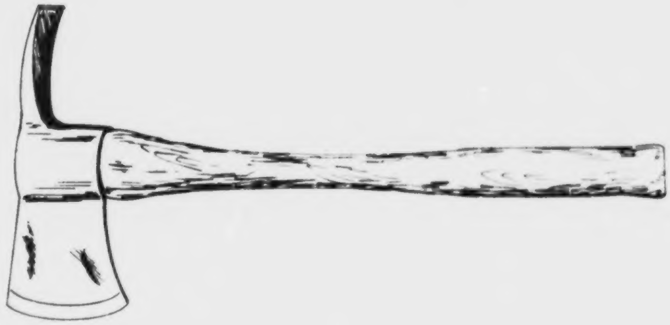
Double bit ax



Single bit ax

- **Pulaski (puh-LASS-key)**—Dig up soil, thick layers of duff and other ground materials; to clear out brush, trees, and snags

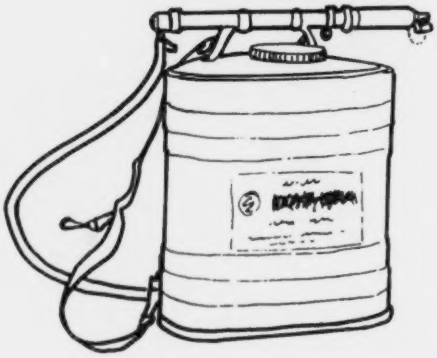
  NOTE: The grub end is used for digging, the ax end for clearing brush. The Pulaski is not commonly used in Southern Forests, but is a major fire-fighting tool in Western and Northern Forests. The Pulaski is used to clear thick duff, to dig and cut roots that can burn underground, and to cut limbs and small trees in areas where dozers and tractors can't go.



Pulaski

- **Backpack sprayer**—Spray water on burning area

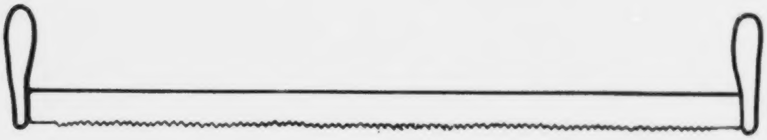
  NOTE: Most pump containers hold five gallons of water. Sometimes the water might have a detergent or chemical wetting agent to help fuels absorb water.



Backpack sprayer

- **Saws**—Buck logs and fell trees in the fire lane areas

  NOTE: Cross-cut hand saws and chainsaws are used.



Crosscut Saw

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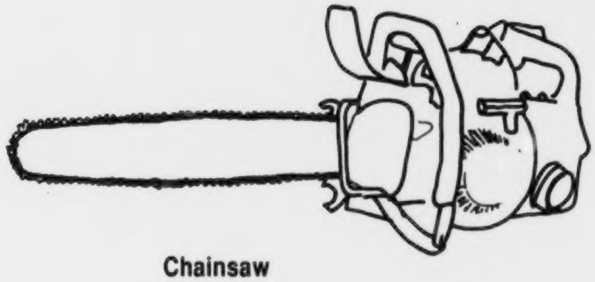
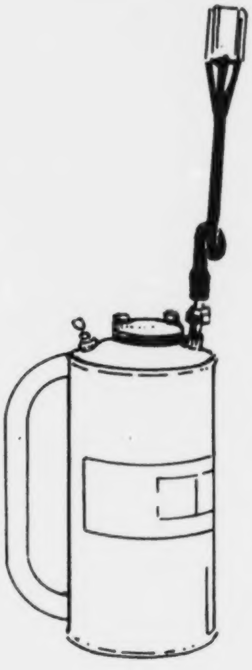


Chainsaw

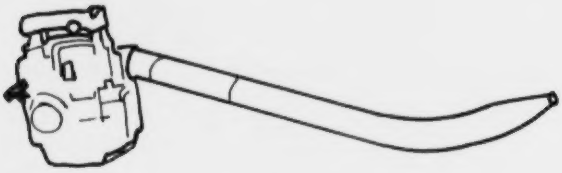
- **Drip torch**—Start backfires and prescribed fires

  NOTE: The drip torch is a hand-carried or backpack canister filled with a gasoline and oil mixture or other flammable chemical. At the end of the rod is a burning wick. When the canister is turned upside down, the mixture flows out, passes by the wick, and catches fire. The ignited fuel drops on to the ground and starts a new fire.



Drip Torch

- **Leaf blower**—Create a fire line in rocky areas



Leaf Blower

NOTE: The leaf blower blows the leaves and lightweight duff away from soil and rocks.

OBJECTIVE 12

Choose the best word or phrase to complete statements about fire control. (Supplement 3)

NOTE: Fire management is a fairly recent development, as science, technology, and communications have become more advanced and available.

- **Fire prevention**—Since 9 out of 10 wildfires are started by people, usually out of carelessness, 90% could be prevented. The keys to prevention are:
  - Educational programs such as Smokey the Bear, Woodsy Owl, and Project Learning Tree, television, radio, posters, exhibits, movies, videotapes, personal appearances and lectures by foresters and fire fighters, and articles in newspapers and magazines.
  - Law enforcement as a deterrent. A person who allows a brush fire to get out of control is guilty of a misdemeanor. A person who deliberately sets a fire commits a felony and is subject to a fine and imprisonment.

- **Presuppression**—Involves planning, organization, and detection. Planning for fire emergencies and organizing fire-fighting teams and equipment to act swiftly and efficiently when a fire strikes is critical if fires are to be contained and put out as quickly as possible.

  The first step in fire suppression is **detection**. Early and accurate detection means fire fighters can be on the scene as soon as they can get away and travel to the site with the proper amount and type of support.

  When we think of detection, we think of the forest ranger sitting alone at a radio in the lookout tower. Times have changed. Tower crews are now assisted by closed-circuit television systems, planes and helicopters. The spotter determines the location of a fire and radios a headquarters station. Sophisticated computer programs analyze wind, temperature, humidity, available fuel, topography and other factors to predict fire behavior and determine the support needed at the site.

  Technology serves detection with a number of remote sensing devices:

  - Infrared systems locate fires by electromagnetic radiation wavelengths.
  - Radar bounces microwave energy off of clouds to locate possible electrical storms with lightning that could start a wildfire.
  - Sferics is a method of tracking lightning by following its discharged electromagnetic energy.
  - Satellites are also used to locate and track fires.

- **Suppression**—The fire fighters' objective is to control and extinguish the fire. There are three goals in suppression: (1) to rob the fire of fuel such as trees, litter, branches, and slash, (2) to reduce the temperature and (3) to cut off oxygen to the fire .

  NOTE: See Objective 6 on the Fire Triangle.

  Fire fighting methods to achieve these goals include:

  - Removing fuel: Fire fighters cutting away brush, logs and small trees to make a fire lane, or crawler tractors plowing a fire lane
  - Smothering the fire with shovels full of dirt
  - Building backfires to burn against the wind and reduce the amount of fuel
  - Felling snags in advance of the fire with chainsaws or tractors
  - Dropping or spraying water or chemicals from airplanes and helicopters
  - Parachuting smoke jumpers and equipment into areas without roads
  - Airplanes and helicopters may direct ground efforts by radio as the fire moves

  NOTE: In the Pacific Northwest, where fires break out every season, there are laws that say everyone in the area, (including tourists passing through) can be recruited to fight a major fire. Many residents carry shovels, food, water, and a change of clothing in their vehicles, anticipating possible recruitment.

  Sometimes the management plan is to not control the fire, but to let it burn unchecked to maintain the natural ecology of the area. This is known as a "let-burn" policy, and is very carefully studied, administered and evaluated by forest managers. These fires are watched closely and controlled, if necessary.

- **Mop-up and patrol**—The last stages of fire fighting, the dirtiest work, and often dangerous to fire fighters. The mop-up crew makes sure that **all** fires are out. Their purpose is to keep the fire from spreading past its perimeters or past the fire breaks built to stop it. If they fail, smoldering embers can break into a new wildfire with the next windy day.

  Equipped with axes, shovels, and backpack water or chemical sprayers, the mop-up crew moves in after the fire is controlled. They break up and spread fuel, make sure no fires remain, and remove smoldering snags or dead trees near unburned areas. During mop-up fire fighters must:

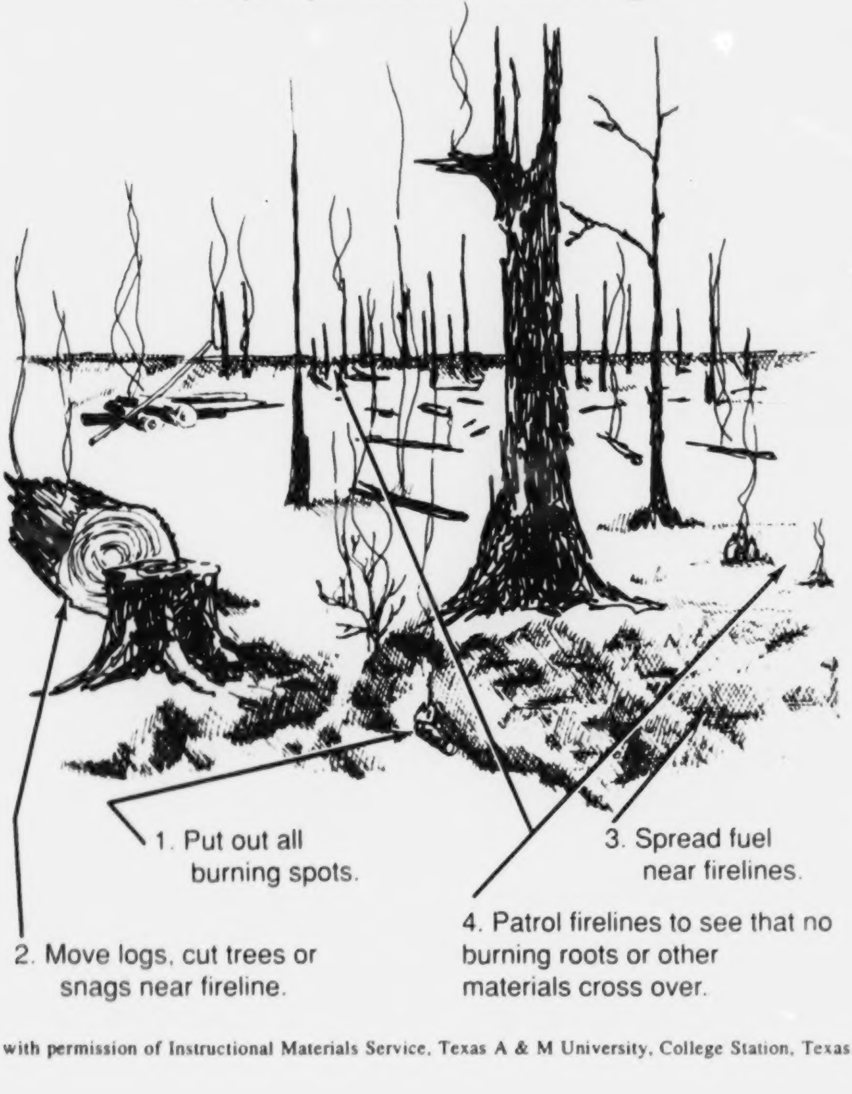
  - Put out all burning spots.
  - Move logs, cut trees or snags near fire line.
  - Spread fuel near firelines.
  - Patrol firelines to see that no burning roots or other materials cross over.

  Mopping-up is dangerous because snags can fall without warning, the ground is uneven and footing is not clear. If the mop-up crew has fought the fire, exhaustion can lead to serious accidents.

  The patrol crew stays in the burn area and continues to watch for burning roots or other materials that can cross over the fire line until the area is completely safe.

"Mopping Up" After a Fire

After fire has been controlled,
"mop up" before leaving it.



1. Put out all burning spots.
3. Spread fuel near firelines.
4. Patrol firelines to see that no burning roots or other materials cross over.
2. Move logs, cut trees or snags near fireline.

Adapted with permission of Instructional Materials Service, Texas A & M University, College Station, Texas.

OPINIONS FROM THE YELLOWSTONE FIRELINE

In the past 28 years I've been both Fire Boss and grunt, digging line with a pulaski. I've fought, taught, set and investigated fires. But I've not seen a fire season like this past one.

As I write this in early fall, the fires are still not completely out. But before the politicians start swinging axes and slinging mud, there are some things that need to be said.

The solution might appear simple: eliminate the "let-burn" policies, and the fire problems disappear. But these concepts are the result of years of study by resource professionals, not some ecologist's whim. Let-burn is not as simple as: "If it's man-caused, suppress it; if it's natural, let 'er rip!"

"Controlled burning will solve the problem of fuels buildup," some say. But isn't that what "let-burn" really is—burning under anticipated conditions. Controlled (which is a misnomer in any fire season) or prescribed burning is the application of fire to reduce forest fuels or bring about some defined management objective. Prescribe-burn policies are little different from let-burn, except that the time of ignition is planned and fuel conditions are better described. Even fires carefully prescribed are subject to the fickle whim of winds, moisture, and temperature.

Not all of the catastrophic fires of 1988 were let-burn. One was started by an outfitter's stove, another by a logging operation. Arsonists had a busy time around Missoula for a month or so. Lightning starts on the Flathead, Kootenai, and Bitterroot forests were attacked swiftly and aggressively, yet many grew to immense proportions. Fires amounting to a flicker at daybreak erupted to a thousand acres by nightfall. Some fires known to exist could not be found because of the heavy smoke pall.

In a typical fire season, firefighters do not generally stop a fire until Mother Nature lets them do so: the winds die down, evening coolness and dew help out, or maybe a shower comes by. Last year nothing helped—the winds kept up, no moisture came, the temperature stayed high.

Humans are rather puny when confronted with the might of nature. No one suggested that Mt. St. Helens should have been corked. How can we expect humans to halt 100,000 acres aflame? Eliminating let-burn will only lead to the same situation some dry summer in the future.

Let-burn is a good and useful tool in the forestry kit. The wise craftsman doesn't blame his tool when a job gets out of hand—he learns to use it more proficiently. We must not eliminate the let-burn device—we must learn to use it better, to predict a little more accurately, and to hold suspect the prescription parameters and the expected results.

Despite the apparent devastation in Yellowstone Park, officials there have an opportunity to redefine its role in the park system. Just as Mt. St. Helens gives visitors a graphic look back into the beginning of time, Yellowstone can give its visitors a long look into the beginnings of forest, recreation of wildlife habitat, different scenic perspectives—the new forest coming to be amid the geysers and the fumaroles.

The soils will stabilize, vegetation will come back, wildlife will return, the scars will heal. Ecology happens!

by DONALD M. WOOD
AFA Field Representative
Missoula, MT

The "let-burn" policy of the National Park Service is a good one—but perhaps needs some modification. The Service, aware of the abnormally dry weather and explosive fuel buildup, might have moved to contain some of the June lightning fires. However, given the conditions of heavy fuels, low humidity, and winds up to 60 mph, it is doubtful that the destruction could have been reduced by any human intervention.

In observing the controversy over the Yellowstone fires and how our wildlands should be managed, I am reminded of a writing of Thomas Dreier: "There are two men ... the essential difference between them is that one loves the beauty of the world, the other hates its ugliness... The former is happy; the other is miserable."

by MARLIN H. BRUNER
Clemson, S.C.

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IDENTIFY FOREST FIRE PROTECTION PRACTICES

Fires are started many different ways. Most fires are caused by human carelessness or by incendiarism and could have been prevented. Wild fires burn thousands of acres every year using both manpower and money to fight them. Education is one way to combat fires caused by man. The table on the following page shows the causes of southern area fires for 1990.

1990 SOUTHERN AREA FIRE STATISTICS

FIRE BY CAUSES

STATES	Lightning	Campfire	Smoking	Debris Burning	Arson	Equip	Railroad	Child	Misc	Total Fires	Acres Burned	Average Acres/ Fire
ALABAMA	106	79	366	1,789	2,923	404	74	157	540	6,438	46,042	
%	1.7%	1.2%	5.7%	27.8%	45.4%	6.9%	1.1%	2.4%	8.4%	100%	100%	7.15
ARKANSAS	70	17	102	680	1,210	158	37	67	235	2,576	33,161	
%	2.7%	.7%	4.0%	26.4%	47.0%	6.1%	1.4%	2.6%	9.1%	100%	100%	12.87
FLORIDA	1364	114	149	1,049	1,754	383	72	310	1,470	6,665	259,979	
%	24.5%	1.7%	2.2%	15.7%	26.3%	5.7%	1.1%	4.7%	22.1%	100%	100%	39.01
GEORGIA	793	112	510	3,518	2,106	727	214	380	725	9,085	37,520	
%	8.7%	1.2%	5.6%	38.7%	23.2%	8.0%	2.4%	4.2%	6.0%	100%	100%	4.13
KENTUCKY	2	23	32	307	644	43	9	27	175	1,262	21,217	
%	.2%	1.8%	2.6%	24.3%	51.0%	3.4%	.7%	2.1%	13.9%	100%	100%	16.81
LOUISIANA	24	9	16	770	3,629	24	23	10	134	4,639	50,429	
%	.5%	.2%	.4%	16.6%	78.2%	.5%	.5%	.2%	2.9%	100%	100%	10.87
MISSISSIPPI	43	11	162	1,874	3,992	102	39	53	228	6,504	70,164	
%	.7%	.1%	2.5%	28.8%	61.4%	1.6%	.6%	.8%	3.5%	100%	100%	10.79
NORTH CAROLINA	129	41	354	1,353	1,194	197	36	291	384	3,979	26,134	
%	32%	1.0%	6.9%	6.9%	30.0%	5.9%	.9%	7.3%	9.7%	100%	100%	6.57
OKLAHOMA	12	11	6	482	942	85	9	8	21	1,576	34,717	
%	.8%	.7%	.3%	30.6%	59.8%	5.4%	.6%	.5%	1.3%	100%	100%	22.03
PUERTO RICO	0	0	281	1,188	918	609	0	111	4,246	7,353	11,772	
%	0.0%	0.0%	3.5%	16.2%	12.5%	8.3%	0.0%	1.5%	57.7%	100%	100%	1.6
SOUTH CAROLINA	262	27	300	1,717	2,455	318	85	250	454	5,863	26,464	
%	4.5%	.5%	5.1%	29.3%	41.9%	5.3%	1.4%	4.3%	7.7%	100%	100%	4.51
TENNESSEE	19	20	52	1,027	858	75	20	21	186	2,278	15,675	
%	.8%	.9%	2.3%	45.1%	37.7%	3.2%	.9%	.9%	8.2%	100%	100%	6.88
TEXAS	40	25	26	758	544	47	27	25	85	1,577	27,644	
%	2.5%	1.6%	1.7%	48.0%	34.5%	3.0%	1.7%	1.6%	5.4%	100%	100%	17.53
TOTAL	2,864	489	2356	16,512	23,169	3,167	645	1,710	8,883	59,795		
%	4.78%	0.82	3.94	27.61	38.75	5.30	1.08	2.86	14.86			

Courtesy of the Southern Area Interagency Coordination Center, Atlanta, Georgia.

THE WILDLAND-URBAN INTERFACE

When the Yellowstone Fire approached Grant Village, fire fighters had to take fast, serious action to save the community. They waited until night, when temperatures were cooler, and set a series of backfires to change the fire's course. The strategy worked and the village did not burn.

Not all fire fighters and home owners have been so lucky. Where wildlands meet populated zones, areas known as wildlands-urban interfaces, fire and fire fighting have become more serious problems than anyone could have predicted.

City people move to the country and build homes on 5-10 acre tracts or "ranchettes" that border on grasslands or forest lands. Unlike the people who lived along wildlands in the 1940s, 50s and 60s, these people don't have the knowledge of and experience with fires to know how to protect their homes and property. They don't have the same respect for fire that their forerunners had, nor do they know about simple safety procedures and precautions that can prevent the losses caused by wildfires: keeping grass and brush cut back away from buildings, using metal vents and fire resistant roofing materials rather than plastics or wood; using masonry rather than wood; using caution when operating machinery in extremely dry seasons.

It's not only the residents who are unprepared to meet a fire at the wildland-urban interface. The fire fighters, too, find themselves in difficult positions. Forest fire fighters are not trained or equipped with the proper tools to suppress house fires, nor can town and city fire fighters protect wildland homes from sweeping surface and ground fires. Furthermore, each group has its own radio and fire-fighting codes and terminology so that communication is difficult. The value judgments and fire protection responsibilities of forest and urban fire fighters are very different. The knowledge of the dangers and risks are not the same, so they have no clear lines for making decisions such as which houses can be saved and which ones they won't attempt to save.

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The problem is compounded by the lack of careful planning and land development regulations. Bridges often will not support the weight of fire trucks; community water systems don't have enough pressure to use fire fighting equipment effectively; and streets, cul-de-sacs and driveways may not have enough space to maneuver fire-fighting equipment. If dozers are used to fight the wildland fire, they can severely damage the property they are trying to protect.

How serious is the wildlands-urban interface problem? On "Black Friday" in Florida, over 600 homes were lost in just this situation. In 1988, wildlands fires destroyed homes in Kentucky, Georgia and Tennessee. This problem truly belongs to the 80s and 90s as more people want to move "back to the land."

The wildland-urban interface opens a new area of concern, a new area of study, and a new opportunity for foresters. Training programs are being developed to help fire fighters cross over from one area to the other. Education programs for residents and stricter regulations in home areas can reduce the risk, the danger and the loss.

CREATE A FIRE SCENARIO

A scenario is a forecast, or a hypothetical (imagined) situation developed from facts, experience, and opinions. Businesses often use brainstorming to create scenarios and project possible outcomes, given several possible sets of circumstances.

Brainstorm with a small group of your classmates. Choose one person as the recorder to keep track of your ideas and a speaker to present the group's scenario to the class.

Here are the rules of brainstorming:

Step 1—For at least 3 minutes, share ideas on a specific subject, such as what the fire looks like. The recorder writes down key words for every idea (sometimes they come so quickly that two recorders are needed). No idea is too far out, too silly, too dumb at this stage. MAKE NO JUDGMENTS. Accept everyone's idea and build on each other's input.

Step 2—Choose which ideas to explore and eliminate those that aren't acceptable at this time (don't throw away the paper or cross it out so you can't read it—you may come back to it).

EXAMPLE: Types of fires: ground fire, crown fire, combination, blowup. Select the one you want to work with.

Step 3—Explore the possibilities and come up with a general idea.

Step 4—Refine your idea and follow it to its conclusion.

Imagine what it would be like to fight a fire. Consider what type of fire you have, what the fire looks like, the heat, the smells, the sound, the kind of work you might be doing and what the people around you might be doing. What tools are you using? What kind of vehicles or equipment are you operating? What clothes are you wearing? What caused the fire?

Let everyone in your group have a job fighting the fire.

Share your scenario with the other groups. After you have completed Assignment Sheet 2, compare your scenario with a fire fighter's scenario.

ASSIGNMENT SHEET 1

IDENTIFY FOREST FIRE PROTECTION PRACTICES

XIV

NAME ______________________________ SCORE ________

OBJECTIVE 13

Observe a fire scene.

INTRODUCTION

No amount of reading or looking at photographs can take the place of actually being at the site where fire has burned the forest. Your first-hand observations and impressions will help you understand the damage and help you appreciate that prevention is the most important part of protecting the forest from fire.

DIRECTIONS

Visit the site of a forest fire. Take this assignment sheet and a clipboard, pencils or pens, and binoculars if you have them. Wear boots and old pants. Take a canteen of drinking water.

Observe the items listed below and all other factors you find.

PART 1 - Research prior to observation

1. Where was the fire located?

____

____

____

2. When did it occur?

____

____

____

3. What caused it?

____

____

____

4. How much land was burned?

5. Describe the land before the fire, in terms of timber acreage, open grasslands, water, etc.

PART 2 - On-site observation

1. What is your first impression?

2. Describe the firebreaks. How do you think they were made? What natural firebreaks were used?

3. Describe the trees and the damage.

4. What fuel remains?

5. How does it smell?

____

____

____

6. How does the ground look?

____

____

____

7. Feel the soil underfoot and with your fingers. Describe it.

____

____

____

8. Describe new growth at the site.

____

____

____

9. Describe wildlife signs and sounds.

____

____

____

10. Other observations:

____

____

____

ASSIGNMENT SHEET 2 — IDENTIFY FOREST FIRE PROTECTION PRACTICES XIV

NAME ______________________________ SCORE _______

OBJECTIVE 14 **Write a report on interviewing forest fire fighters.**

INTRODUCTION Fighting forest fires, whether controlling a prescribed burn or struggling against a raging wildfire, is a job that demands long hours of hard, dirty work.

Why do foresters and forest fire crews do it? Find out by interviewing men and women who have fought a forest fire and reporting on the interview.

DIRECTIONS Interview two guests in your class who have fought forest fires. Take notes on the interviews and write a report.

Have someone check the report for correct spelling and grammar.

The length of the report will be determined by your teacher, depending on the content of the interviews.

Some suggested questions are listed below. Make your own list of at least three more questions. Take notes during the interview.

How many fires have you fought and where were they?

How did the fire(s) start?

Which was the smallest fire? Which was the biggest fire?

Which one do you remember most and why?

What was your job (or jobs)?

Please describe fighting a fire.

List your questions.

____

____

____

____

____

____

____

____

If guest fire fighters can't come to class, compile a list of people to interview and their telephone numbers. You can interview them in person or over the telephone. Be sure to state your name and your purpose and to thank the person when the interview is finished.

ASSIGNMENT SHEET 3

IDENTIFY FOREST FIRE PROTECTION PRACTICES

XIV

NAME ______________________________ SCORE ________

OBJECTIVE 15

Analyze information on forest fires.

INTRODUCTION

The forest fires we see on television are usually the biggest and most dramatic, dangerous fires of the season. However, there may be thousands of fires in your state every year that aren't reported on the news. If you and your class put together information on forest fires in the Southern Region, you will understand more about forest fires and their causes and effects.

DIRECTIONS

Use the information provided in Supplement 1—1990 Southern Area Fire Statistics. You may add information collected by your teacher, or you can collect additional information from the State Forestry Department, the Bureau of Land Management or an office of the U.S. Forest Service. Find out more about the conditions, causes, and costs of prescribed fires and wildfires in the Southern Region.

PART 1

Answer the following questions.

1. a. According to the total numbers of fires and the percent of the total fires, what caused the most fires?__________

   b. How many? __________

   c. What percent of all fires? __________

2. Complete this table:

CAUSES OF FIRES IN 1990
IN THE SOUTHERN REGION

Cause	Number	% of Total
Natural		
Equip/Railroad		
Misc./Human error		
Totals		

3. Which states lost over 50,000 acres?

____

____

4. What was the total average number of acres per fire in these states?

____

____

5. Rank the states according to the total acres burned in 1990. Rank the state with the most acres burned as "1," rank the state with the second greatest number of acres burned as "2" and so on.

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________
5. ______________________________
7. ______________________________
8. ______________________________
9. ______________________________
10. ______________________________
11. ______________________________
12. ______________________________
13. ______________________________

6. Rank the states according to the total number of fires in 1990. Rank the state with the most fires as "1," rank the state with the second greatest number of fires "2" and so on.

   1.
   2.
   3.
   4.
   5.
   6.
   7.
   8.
   9.
   10.
   11.
   12.
   13.

7. a. How does Puerto Rico rank in the number of acres per fire?

   b. How does it rank in the total number of acres burned?

   c. How does Puerto Rico rank in the total number of fires?

   d. Explain the difference in rank between questions a and b (as one ranking) and question c.

8. Rank the causes of fires, beginning with "1" as the cause of the greatest number and "9" as the cause of the least number of fires.

1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________
6. ____________________
7. ____________________
8. ____________________
9. ____________________

PART 2

On a separate piece of paper, make a table or graph that shows a single group of statistics in the information in Supplement 1. You may use pencil and paper, colored markers or computer graphics to draw bar graphs, pie charts, picture graphs or whatever graphic representation you wish in order to show the causes and/or losses. Your work should be based on individual groups and have titles.

EXAMPLES: Total Fires Caused by Lightning in the Southern Region in 1990 by States
Percent of Fires Caused by Children in 1990 by States
Causes of Fires in Oklahoma in 1990
Total Acres Burned in the Southern Region in 1990 by States
Comparison of Burned Acres and Total Protected Acres in the Southern Region in 1990
Total Fires in the Southern Region by State
Acres Lost Per Fire in the Southern Region in 1990 by State
Total Fires Compared with Total Burned Acres in the Southern Region by States

NOTE: To make a pie chart, use a protractor to get the correct angle. Take the percentage you want to show, convert it to a decimal and multiply it times 360°.

Total % of fires caused by smoking, 3.94

Decimal .0394 x 360 = 14.18°

Round answer to 14.2°

% of fires caused by arson in Georgia, 23.2%

Decimal .232 x 360 = 83.52

Round answer to 83.5°

ASSIGNMENT ANSWERS

IDENTIFY FOREST FIRE PROTECTION PRACTICES XIV

ASSIGNMENT SHEET 1

PART 1

Students should have visited the site of a forest fire and answered all five questions completely.

PART 2

Students should have answered all ten questions completely. Answers should be written clearly and have details on students' perceptions.

ASSIGNMENT SHEET 2

Reports should be evaluated according to content, accurate reporting of interview information, intelligent selection of information, good spelling and grammar and neat presentation.

ASSIGNMENT SHEET 3

1. a. Arson
   b. 23,169
   c. 38.75%

2.

Natural	2,864	4.78%
Equip/Railroad	3,812	6.38%
Misc./Human error	53,119	88.84%
Totals	59,795	100.00%

3. Florida, Louisiana, Mississippi

4. 20.22

5. 1. Florida
   2. Mississippi
   3. Louisiana
   4. Alabama
   5. Georgia
   6. Oklahoma
   7. Arkansas
   8. Texas
   9. South Carolina
   10. North Carolina
   11. Kentucky
   12. Tennessee
   13. Puerto Rico

6. 1. Georgia
   2. Puerto Rico
   3. Florida
   4. Mississippi
   5. Alabama
   6. South Carolina
   7. Louisiana
   8. North Carolina
   9. Arkansas
   10. Tennessee
   11. Texas
   12. Oklahoma
   13. Kentucky

7. a. 13
   b. 13
   c. 2
   d. Even though there were many fires, most or all were very small.

8. 1. Arson
   2. Debris burning
   3. Miscellaneous
   4. Equipment
   5. Lightning
   6. Smoking
   7. Children
   8. Railroad
   9. Campfires

PART 2

Check that the graph or chart is appropriately done. All numbers should represent or add up to the proper totals in the table, and percentages should total 100%. Extra credit may be given for originality, neatness, or difficulty.

WRITTEN TEST

IDENTIFY FOREST FIRE PROTECTION PRACTICES

XIV

NAME ______________________________ SCORE ________

OBJECTIVE 1

Match terms associated with forest fire protection practices to their correct definitions. Write the correct letters in the blanks.

____ 1. A fire started when sparks from the main fire ignite a new fire

____ 2. A condition that can start or feed a fire

____ 3. Forest litter and other organic debris in various stages of decomposition on the forest floor

____ 4. The intentional destruction of property by fire

____ 5. All burnable vegetation above six feet from the ground

____ 6. Soil lost because water carries it downhill into valleys, streams, rivers, and lakes

____ 7. Setting a line of fire in front of the main fire; it burns against the wind, robbing the main fire of fuel

____ 8. To discover the presence or existence of a fire

____ 9. A barrier, either already existing or built before a fire occurs or spreads, used to stop or check fires

___ 10. A deep valley with high, steep slopes

___ 11. Intensity, speed, spread, temperature and height of burning

___ 12. Containing the fire within a certain perimeter

___ 13. Uncontrolled forest fires

___ 14. Bare soil, containing nothing that will burn

___ 15. All the work of extinguishing a fire

___ 16. The front edge of an advancing fire

a. Aerial fuels
b. Arson
c. Backfire
d. Canopy cover
e. Canyon
f. Detection
g. Drift
h. Duff
i. Erosion
j. Exhaustion
k. Fire behavior
l. Fire control
m. Fire hazard
n. Fire lane or fire break
o. Flash fire
p. Forest fire
q. Incendiarism
r. Mineral soil
s. Runoff
t. Slag
u. Spot fire
v. Suppression
w. Wildfire
x. Fire line

OBJECTIVE 2

Select from a list true statements concerning wildfires. Write an "X" in the blank before each true statement.

____ 1. The Miramichi Fire destroyed over 1.3 million acres, but luckily took no human lives.

____ 2. The Peshtigo Fire was the worst fire in U.S. history, causing the death of more than 1,500 people.

____ 3. The Miramichi Fire and the Peshtigo Fire both started after long, dry periods.

____ 4. Most wildfires are blowups.

____ 5. In a blowup fire, winds at the center can become as violent as a cyclone.

____ 6. The Yellowstone Fire was a "let burn" fire until high winds caused it to blow up.

____ 7. Updrafts in a blowup fire can throw burning material 5,000 feet up in the air.

____ 8. Wildfire destroys timber, property, wildlife, domestic livestock, human life and health, but actually helps purify water supplies.

OBJECTIVE 3

Match causes of wildfires to their descriptions. Write the correct letters in the blanks.

____ 1. Fires started, usually by landowners, to burn trash, get rid of brush, or to clear land, get out of hand and spread to nearby forested areas

____ 2. Most are caused by human carelessness or error and could have been prevented

____ 3. Fires are set intentionally, some under the mistaken belief that burning the underbrush will kill ticks and other insects and some set deliberately and maliciously to burn the forest

____ 4. Occurring mainly in the West; the only important natural and, so far, unpreventable cause of fires

____ 5. Fires are caused by automobile drivers, hikers, campers, hunters, fishermen and woods workers tossing cigarette butts or matches in the forest

____ 6. Sparks from engine fires, exhaust, electrical and other problems from operating on roads and trails and in forested areas

____ 7. Reduced numbers of fires in recent years due to improved spark arresters and the conversion to electric and diesel equipment

____ 8. Building fires in unsafe places or abandoning still-burning campfires

a. Incendiary
b. Campers and picnickers
c. Railroad operations
d. Lightning
e. Weapons
f. Spontaneous combustion
g. Careless smokers
h. Animals
i. Children playing with matches
j. Arson
k. Machinery
l. Miscellaneous causes
m. Road racing
n. Burning debris

OBJECTIVE 4

List effects of wildfires. Write six harmful and two beneficial effects of wildfires.

Harmful

Beneficial

OBJECTIVE 5

Select from a list true statements concerning prescribed burning. Write an "X" in the blank before each correct answer.

Prescribed burning

____ 1. A fire lane is built around the area to be burned, combining natural barriers with a plowed fire break.

____ 2. Prescribed burning means applying fire to land under very carefully controlled conditions in order to achieve certain management goals.

____ 3. A backfire is built at the rear of the area.

____ 4. Gusty, medium velocity winds are ideal for prescribed burning.

____ 5. Burning can only take place under specific, proper conditions.

____ 6. A team of foresters carefully set the fire and it is strictly controlled.

____ 7. The technique is selected according to the wind direction and velocity.

Objectives of prescribed burning

____ 1. Control insect damage

____ 2. Reduce water runoff

____ 3. Prepare seedbed site

____ 4. Kill ticks

____ 5. Reduce air pollution

____ 6. Reduce fire-hazards

____ 7. Create wildlife habitat

____ 8. Reduce competition for the harvest crop

Additional benefits

____ 1. Improves the beauty and appeal of an area

____ 2. Improves access for recreational use and logging

____ 3. Allows regeneration of tree species that would not be able to compete without the benefit of fire

____ 4. Increases grasses, seeds, and browse for wildlife and domestic stock

____ 5. Improves the stability of the land

____ 6. Clarifies property lines

OBJECTIVE 6

Choose the best word or phrase to complete statements about the Fire Triangle. Circle the correct answers. Questions may have more than one correct answer.

1. Factors which will make a fire burn faster are _____ .

   a. backfires

   b. light fuels

   c. wind

   d. loosely-arranged fuel

   e. tightly-arranged fuel

   f. heavy fuels

2. Swatting or covering with dirt breaks the Fire Triangle by removing the _____ .

   a. heat

   b. fuel

   c. oxygen

   d. water

3. Cutting a firebreak and building a backfire breaks the Fire Triangle by removing the _____ .

   a. fuel

   b. heat

   c. oxygen

   d. water

4. Factors that will make the fire burn hotter include _____ .

   a. backfires

   b. heavy fuels

   c. light fuels

   d. wind

5. All of the following are part of the Fire Triangle except _____ .

   a. fuel

   b. oxygen

   c. heat

   d. water

6. Spraying with water or chemicals breaks the Fire Triangle by removing the _____ .

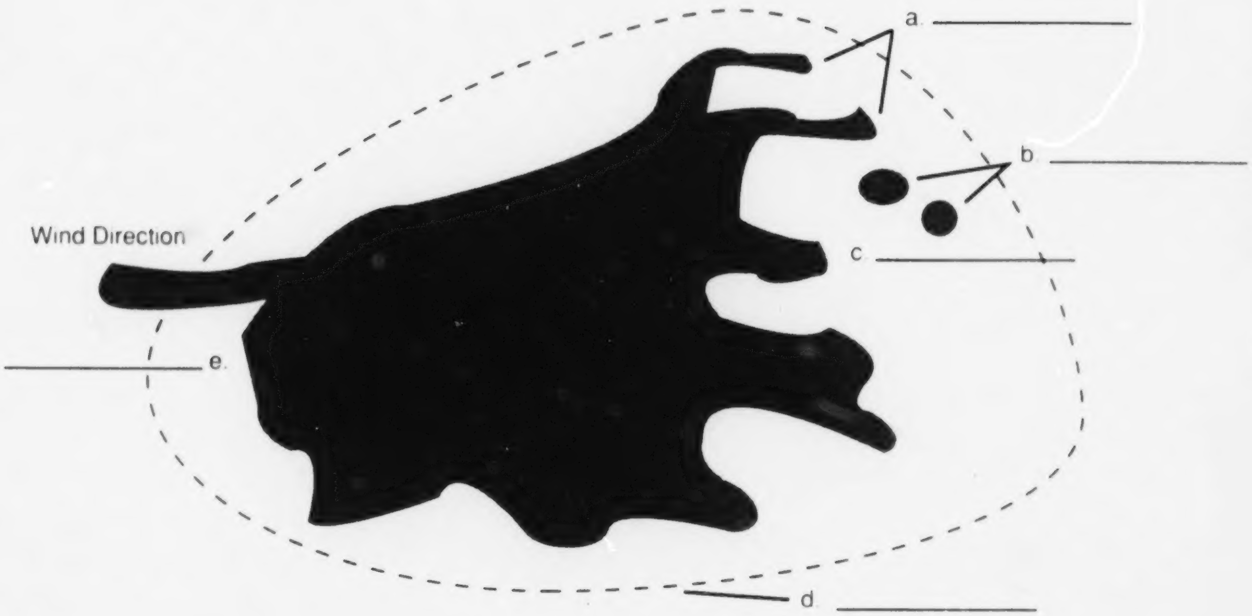
   a. fuel

   b. heat

   c. oxygen

   d. water

OBJECTIVE 7 | **Label parts of a forest fire.**



OBJECTIVE 8 | **Name the types of forest fires, given a newspaper description.**

Write in the blank either surface fire, ground fire or crown fire.

____________ 1. "It's the most common type of forest fire," fire fighter Susan Miller said, "especially here in Oklahoma and across the South. We were lucky since it rained last week and there wasn't much wind, and we could handle it before it became a more destructive fire."

____________ 2. Fire fighters got to the scene quickly, with enough personnel and equipment to control the fire. Although limited to several hundred acres, the fire destroyed seedlings and young trees and scarred large trees, leaving them open to insect and disease damage.

__________ 3. **This was a dramatic fire, the type you see in movies. Aerial fuel, fed by high winds, burned thousands of acres of conifers.**

__________ 4. This fire, in the Lake Erie area, smoldered for over six weeks before it was discovered. Most vegetation in the area was destroyed because of root damage.

OBJECTIVE 9

Choose the best word or phrase to complete statements about factors influencing fire behavior. Circle the correct answers. Questions may have more than one correct answer.

1. Canyons and slopes can create patterns of air movement that ______ .
   a. affect mostly conifers
   b. govern the shape of the fire
   c. intensify the fire
   d. move the fire downhill
2. The statements that BEST describe the fire season are ______ .
   a. buildup of fuels
   b. extended dry periods
   c. high relative humidity
   d. July-October
   e. September-December
   f. strong winds
3. Fires are most likely to start and burn most intensely when vegetation is driest and the winds are strongest: on sunny days during the ______ .
   a. early afternoon
   b. evening
   c. late afternoon
   d. middle of the afternoon
   e. morning

4. All of the following affect fire behavior EXCEPT_______ .

   a. age of the timber

   b. air movements

   c. fire season

   d. humidity

   e. kind and quantity of the forest fuels

   f. moisture content of the forest fuels

   g. time of day

   h. topography

5. Aerial fuels, except for large limbs and snags _______ .

   a. burn with a lot of smoke

   b. burn quickly

   c. cause trees to burn completely

   d. contribute to a faster spread

6. "Smokes" are persistent small fires within the large fire. They burn in ______ .

   a. aerial fuels

   b. heavy ground fuels

   c. medium ground fuels

   d. small fuels

7. Horizontal wind movement _______ .

   a. blows east, west, north and south

   b. causes air to rise

   c. creates movement at different levels

   d. makes spot fires

8. Forest fuel is MOST LIKELY to ignite between ______ .

a. 900-1000° F.

b. 800-950° F.

c. 775-800° F.

d. 600-880° F.

e. 525-600° F.

9. The most dangerous slope for a fire is the ______ .

a. northeastern slope

b. northwestern slope

c. southeastern slope

d. southwestern slope

10. Steep slopes ______ .

a. burn from the top to the bottom

b. cause the fire to burn hotter and spread faster

c. cause the fuel to dry and heat before the fire reaches it

d. slow the spread of the fire

OBJECTIVE 10

Distinguish between direct and indirect methods of attacking a fire. Write "D" in the blanks before statements concerning direct attack and "I" in the blanks before statements concerning indirect attack.

____ 1. Airplanes spray chemical fire retardant on the leading edge.

____ 2. Backfires are used to rob the fuel supply from the main fire.

____ 3. Fire fighters swat the fire or smother it with water or chemicals.

____ 4. Fire fighters may dig trenches, plow areas around the fire, or use dozers to clear adjoining land.

____ 5. Fire fighters use natural barriers such as roads, streams, and cultivated fields and build fire breaks as needed.

____ 6. Fire fighters use rakes and shovels to clear the ground to mineral soil, and throw dirt onto the fire.

____ 7. Used on small, slow-burning fires without too much heat.

____ 8. Used on hot, fast-burning fires.

____ 9. Working directly on the burning edge of the fire.

___ 10. Working back from the burning edge of the fire.

OBJECTIVE 11

Match fire-fighting tools to their uses. Write the correct letters in the blanks.

____ 1. Buck logs and fell trees in the fire lane areas

____ 2. Clear out brush, trees, snags and other materials

____ 3. Dig up soil, thick layers of duff and other ground materials; to clear out brush, trees, and snags

____ 4. Remove leaves and twigs to clear fire break

____ 5. Spray water on burning area

____ 6. Used to put out grass fires

____ 7. Start backfires and prescribed fires

____ 8. Create a fire lane in rocky areas

a. Axes

b. Backpack sprayer

c. Beater

d. Buster

e. Drip torch

f. Hose and nozzle

g. Pulaski

h. Rakes

i. Saws

j. Swatter

k. Leaf blower

l. Sweepers

OBJECTIVE 12

Choose the best word or phrase to complete statements about fire control. Circle the correct answers.

1. Planning, organization and detection are parts of fire ______ .

   a. control

   b. presuppression

   c. prevention

   d. suppression

2. The purpose of mopping up and patrol is to ______ .

   a. bury dead wildlife

   b. keep the fire from spreading past its perimeters

   c. make the area clean and attractive

   d. remove all snags, burnt trees, brush, logs and remaining slash that might provide fuel for another fire

3. A detection device that locates fires by electromagnetic radiation wavelengths is ______ .

   a. infrared system

   b. radar

   c. satellite

   d. sferics

4. Educational programs and strict law enforcement are the keys to fire ______ .

   a. control

   b. presuppression

   c. prevention

   d. suppression

5. Fire fighting methods include all the following EXCEPT____ .

   a. airplanes and helicopters directing ground efforts by radio as the fire moves

   b. building backfires to burn against the wind and reduce the amount of fuel

   c. crawler tractors plowing a fire lane to remove fuel, smothering the fire with shovels full of dirt

   d. dropping or spraying water or chemicals from airplanes and helicopters

   e. felling snags in advance of the fire with chainsaws or tractors

   f. fire fighters cutting away brush, logs and small trees to make a fire lane

   g. parachuting smoke jumpers and equipment into areas without roads

   h. using a hook and ladder truck to extinguish a fire on top of a snag

6. The stage of fire control that relates to the Fire Triangle is ____ .

   a. mop-up and patrol

   b. presuppression

   c. prevention

   d. suppression

7. When a fire is not controlled, but allowed to burn unchecked to maintain the natural ecology of the area, the forest manager is ______ .

   a. enforcing a reforestation plan

   b. exercising bad judgment

   c. saving taxpayer's money

   d. using a let-burn policy

8. Mopping-up is dangerous for all the reasons below EXCEPT ______ .

   a. snags can fall without warning
   b. the ground is uneven and footing is not clear
   c. fire may break out again with workers in the area
   d. frightened animals may attack without warning

NOTICE The following assignment sheets are not part of the written test. If these activities have not been completed, check with your instructor.

OBJECTIVE 13 **Observe a fire scene.** SCORE ________

OBJECTIVE 14 **Interview forest fire fighters.** SCORE ________

OBJECTIVE 15 **Analyze information on forest fires.** SCORE ________

WRITTEN TEST ANSWERS

IDENTIFY FOREST FIRE PROTECTION PRACTICES

XIV

OBJECTIVE 1

1. u
2. m
3. h
4. q
5. a
6. i
7. c
8. f
9. n
10. e
11. k
12. l
13. w
14. r
15. v
16. x

OBJECTIVE 2

2, 3, 5, 6, 7

OBJECTIVE 3

1. n
2. l
3. a
4. d
5. g
6. k
7. c
8. b

OBJECTIVE 4

Harmful effects answer may include any six of the following:

- Loss of merchantable lumber
- Loss of all timber in very hot fires
- Loss of young trees that would provide future forests
- Scarring of tree trunks causes decay and produces marred lumber, with reduced volume and reduced value
- Fire-scarred trees are open to insect attack and diseases and are more easily blown over by winds
- Loss of plant and animal life
- Soil erosion
- Damage to the soil
- Flood damage and water-supply problems
- The predominant crop can shift from valuable pines or spruces to the growth of inferior species
- Air pollution
- Tourist and recreation businesses lose money

Beneficial effects answer may include any two of the following:

- Destroys old and diseased trees
- Promotes the natural ecological cycle of the forest
- Creates a new type of wildlife habitat and renews the habitat for deer, turkey and other animals

OBJECTIVE 5

Prescribed burning

1, 2, 5, 6, 7

Objectives of prescribed burning

3, 6, 8

Additional benefits

1, 2, 3, 4

OBJECTIVE 6

1. b, c, d
2. c
3. a
4. b, d
5. d
6. b

OBJECTIVE 7

a. Fingers
b. Spot fires
c. Head of fire
d. Fire break (fire line)
e. Rear

OBJECTIVE 8

1. Surface fire
2. Surface fire
3. Crown fire
4. Ground fire

OBJECTIVE 9

1. c
2. a, b, f
3. d
4. a
5. b, d
6. b, c
7. a
8. d
9. d
10. b, c

OBJECTIVE 10

1. I
2. I
3. D
4. I
5. I
6. D
7. D
8. I
9. D
10. I

OBJECTIVE 11	1. i
	2. a
	3. g
	4. h
	5. b
	6. j
	7. e
	8. k
OBJECTIVE 12	1. b
	2. d
	3. a
	4. c
	5. h
	6. d
	7. d
	8. d
OBJECTIVE 13	Refer to answers to Assignment Sheet 1.
OBJECTIVE 14	Refer to answers to Assignment Sheet 2.
OBJECTIVE 15	Refer to answers to Assignment Sheet 3.

OBJECTIVE SHEET

IDENTIFY TYPES OF FOREST DAMAGE

XV

INTRODUCTION

A forester tells about the time when he was in high school and went deer hunting with his dad to their favorite spot. The first year, they saw two dead trees. The second year, they noticed seven dead trees. By the third year, 15-20 trees had died from insect damage and disease.

Insects, disease, weather, wildlife, logging, pollution, and other actions damage trees, causing the loss of valuable timber, an imbalance in the ecosystem and the loss of beautiful forest for hunting and other recreation.

The study of insects and insect damage is **forest entomology**; the study of diseases of trees is **forest pathology**. Learning about damage to the forest and the ways foresters try to maintain an ecological balance combines interesting aspects of forest management, biology, biochemistry, entomology, toxicology, soil science and meteorology.

In this unit, you will get an introduction to bugs and fungus, and you will have an opportunity to observe for yourself the destructive effects of nature and man in the forest.

PREREQUISITES

None

UNIT OBJECTIVE

After completing this unit, the student should be able to identify the causes of damage in the forest, the common methods of control, be able to describe the effects of damage and the relationship of injury, insects and disease. The student will demonstrate these competencies by completing the assignment sheets and written test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with insects, disease, and natural damage to their correct definitions.
2. List the effects of damage.
3. Select from a list true statements about damage, disease, and insects.
4. Choose the word or phrase that completes statements about the type of injury caused by each class of insect.
5. Name the class of insects according to symptoms of damage.

6. Match common diseases of trees to their descriptions.

7. Select from a list true statements about methods of insect control and prevention.

8. Describe types of weather damage.

9. Match animals to descriptions of damage.

10. Complete statements about methods of animal control.

11. Choose the best word or phrase to complete statements about air pollution and other damage.

12. Select from a list true statements about logging damage.

13. Identify insects from a description of damage. (Assignment Sheet 1)

14. Identify insect damage from collected samples. (Assignment Sheet 2)

15. Make a chart of major tree diseases. (Assignment Sheet 3)

16. Report on damage from natural and manmade causes. (Assignment Sheet 4)

IDENTIFY TYPES OF FOREST DAMAGE

PREPARATION

- Obtain materials to supplement unit.

  NOTE: See Suggested Resources.

- Review the instructional outline for this unit. Modify time frames to suit class needs and plan activities for each class period.
- Study the specific objectives to determine those you will cover in your presentation. Decide which objectives should be taught to which students.
- Determine scope and sequence of objectives that you add. Design and develop support materials, including evaluation techniques, for additional objectives.
- Determine how you will schedule time for students to demonstrate competence in the required procedures.
- Obtain slides of forest damage.
- Invite an entomologist, pathologist, or a forester to talk about damage to the forest. Tie this unit in to forest fire protection as well.

  NOTE: Supply guest speakers with the specific objectives and any other appropriate sections of the unit.

DELIVERY

Objective 1

- Discuss with students the kinds of damage they have already seen on their field trips, on the trees in their yards, or in gardens.
- Encourage students to share their knowledge and experiences concerning damage caused by insects, disease, weather and humans.

Objectives 2 and 3

- Discuss with students the effects of damage and the relationship of damage, disease, and insects.

- Discuss how disease is spread in humans and animals and draw parallels to forest diseases and epidemics. Share examples from your own experience and significant epidemics and diseases in your area.

- Discuss human or animal stress and susceptibility to disease, and draw parallels with environmental stress and disease in trees.

Objectives 4 and 5

- Discuss insects common to your area. Show pictures or samples of damaged leaves or twigs, bark or wood with galleries, and wood rot.

- Oklahoma teachers should point out that the pecan weevil is an important pest in Oklahoma.

- Discuss with students classes of insects, symptoms of damage and bark beetles.

- Show students pictures, slides, or preserved specimens of insects and damage.

- Make *Insects and Diseases of Trees in the South* and *Oak Pests: A Guide to Major Insects, Diseases, Air Pollution and Chemical Injury* available to students for color photographs and reference.

- Have students complete Assignment Sheet 1.

- Have students begin Assignment Sheet 2. Give them a reasonable date of completion.

Objective 6

- Discuss diseases common to your area. Show pictures or samples of damaged wood.

- Have students complete Assignment Sheet 2.

- Invite a forest pathologist to discuss diseases, epidemics, and the costs and efforts involved in control and prevention.

Objective 7

- Discuss methods of control and prevention.

- Using their knowledge of silvicultural practices, have students discuss what they have seen and experienced on their field trips related to control and prevention.

- Invite a forester or entomologist to discuss control and prevention.

- Stress that while pesticides are helpful in controlling insects, they can also damage the tree and should be considered a last resort rather than a first course of action.

- Have each student read one article on pesticide use; and then let the students discuss the various considerations of extensive and limited use of pesticides.

Objectives 8 through 12

- Discuss damage caused by weather, animals, air pollution, logging, and other agents.

- Discuss the types of control and prevention possible and affordable for these problems.

- Stress the ecological balance and environmental influences. Let students develop hypothetical cases and project what might happen to the ecological balance and to the forest in the event of catastrophes such as floods, tornadoes, prolonged drought, etc.

- Give special attention to logging damage and specific problems, specific preventive and control measures.

- Invite a forester to discuss logging damage and forest protection.

- Take a field trip to the forest to survey and identify damage. Have students complete Assignment Sheet 4.

APPLICATION

Objective 13

- Use Assignment Sheet 1 to help students identify insects by the symptoms of damage.

- Use scenarios common to your area and from your own experience to foster discussion and interest.

Objective 14

- Use Assignment Sheet 2 to give students firsthand experience with insect damage by collecting and identifying specimens of insect damage.

- Stress neatness and order in displaying the collection.

Objective 15

- Use Assignment Sheet 3 to help students understand the family relationships among diseases and the hosts they infect

Objective 16

- Use Assignment Sheet 4 to give students firsthand experience with all types of forest damage.

- Have students give an oral report to the class, not to exceed three minutes, describing their observations.

- Stress the need for preparation.

EVALUATION

Written test

- Explain to students that they will be asked to demonstrate on the written test actions listed in the specific objectives.

- Give written test.

  NOTE: The written test may be given in sections if desired.

- Evaluate students on assignment sheet activities if not previously done.

- Reteach and retest if necessary.

- Complete appropriate section of competency profiles.

- Review individual and group performance in order to evaluate teaching methods. Adjust scope, sequence, or instructional approaches for additional lessons as required.

SUGGESTED RESOURCES

Audiovisual Materials

- *Something in the Air*, 27 min, VHS, National Council of the Paper Industry for Air and Stream Improvement. Covers acidic deposition and pollutant effects in forests and efforts by public and private interests to deal with it. Discusses biology, chemistry and social aspects of "acid rain."

- *The American Forest: Not to Conquer, but to Continue*, 76 slides with cassette. Describes the status of ecological degradation due to pollutants over the past 20 years. Maintains that the key to sustained production of our forest land is through proper management.

  NOTE: The above materials are available on a free-loan basis from the Forestry Extension Program at Oklahoma State University, 242 Agricultural Hall, Stillwater, OK 74078, (405) 744-5444.

- *Diseases of Trees*, 17 slides with script. Shows symptoms and signs of common tree problems including rots, fungi and foliage diseases.

  NOTE: This slide set is available from the Curriculum and Instructional Materials Center, Oklahoma Department of Vocational and Technical Education, 1500 W. Seventh Avenue, Stillwater, OK 74074. Oklahoma teachers may call (800) 522-5810 ext. 589. Out-of-state teachers may call (800) 654-4502.

Publications

- *Insects and Diseases of Trees in the South*, General Report R8-GR 5, USDA Forest Service, Southern Region, Atlanta, 1985.

- *Oak Pests: A Guide to Major Insects, Diseases, Air Pollution and Chemical Injury*, Protection Report R8-PR7, USDA Forest Service, Southern Region, Atlanta, 1987.

  NOTE: The above publications are available from USDA Forest Service, Southern Region, 1720 Peachtree Street, N.W., Atlanta, GA 30367.

- "Saving Forests the Natural Way," T. R. Torgersen and Anna S. Torgersen, *American Forests*, Jan-Feb, 1990, p. 31. Biological control of pest insects and plants and related information.

- "Expert System Homes in on Forest Foes," *Science News*, July 8, 1989, p. 30. Biological controls.

- "Taking AIM at the Gypsy Moth," *American Forests*, March-April, 1989, p. 36. Integrated Pest Management.

- "What's the Diagnosis?", Wayne S. Moore, *Flower & Garden Magazine*, December, 1988, p. 20. Bark Beetles.

- "Who's Killing the Red Spruce?," *Environment*, July-August, 1989, p. 23.

Speakers

Oklahoma Natural Resources Speakers Bureau sponsored through Oklahoma State University, Division of Agriculture, Oklahoma Cooperative Extension Service - Forestry, Oklahoma Conservation Commission and the Oklahoma Forestry Association. Lists speakers on a variety of forestry-related topics. Speakers operate on a time-available basis. Request a listing of speakers, programs, slide presentations and videotapes from your local extension office or from:

Dr. Steve Anderson
Forestry Dept.
Oklahoma State University
239 Agricultural Hall
Stillwater, OK 74078
(405) 744-9431

Dave Marcouiller
Forestry Dept.
Oklahoma State University
242 Agricultural Hall
Stillwater, OK 74078
(405) 744-5444

Teachers from outside of Oklahoma should contact the Forestry Extension Office in their state.

UNIT REFERENCES

- Anderson, David A. and I. I. Holland, *Forests and Forestry*, The Interstate Printers & Publishers, Inc., Danville, Illinois, 1982.
- Collins, B. McManus, and Fred M. White, *Elementary Forestry*, Reston Publishing Company, Reston, Virginia, 1981.
- *Harvesting Forestry Products*, Texas A&M University, College Station, Texas, 1976.
- *Insects and Diseases of Trees in the South*, General Report R8-GR 5, USDA Forest Service, Southern Region, Atlanta, 1985.
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- Smith, David M., *The Practice of Silviculture*, 8th ed., John Wiley & Sons, New York, 1986.
- Stoddard, Charles H. and Glenn M. Stoddard, *Essentials of Forestry Practice*, 4th ed., John Wiley & Sons, New York, 1987.

IDENTIFY TYPES OF FOREST DAMAGE

OBJECTIVE 1

Match terms associated with insects, diseases, and natural damage to their correct definitions.

- **Cankers**—Protruding wounds like warts caused by disease, insect damage, or injury
- **Defoliate**—To eat the entire leaf
- **Epidemic**—Rapid, explosive increase of an insect population or the rapid spread of disease
- **Flagging**—Dying of branch tips
- **Gall**—Abnormal growth that often serves as a nest or burrow for larvae
- **Galleries**—Tunnels formed by insects chewing through the inner bark
- **Glaze ice**—Rain freezes as it falls, coating branches, leaves, and limbs with a heavy layer of ice
- **Host**—A tree or other organism in which a parasite lives
- **Larvae**—A wormlike immature insect, such as a caterpillar
- **Mine**—To eat only the inside tissue of leaves
- **Necrotic spots**—Areas of dead tissue

  NOTE: "Necro" is a Greek prefix meaning death, corpse, or dead tissue. Look up words beginning with "necro" in a dictionary.
- **Parasitic organisms**—Live on or in another organism, taking nutrients or protection without compensation
- **Pest**—Any undesirable or destructive organism

  EXAMPLES: Destructive insects, rabbits, mice, undesirable bacteria, fungus, birds that eat crops

- **Pitch tubes**—Holes in the bark at the point where insects have entered the tree

  NOTE: Resin builds up at the point of entry, insect droppings, called frass, build up at the base of the tree.

- **Predators**—Organisms which exist by consuming other organisms
- **Saprophytic (sap-ro-FIT-ik) organisms**—Live on dead and decaying matter, breaking down trees and plants into soil
- **Skeletonize**—To eat all but the veins of leaves, giving the appearance of a skeleton
- **Shot pattern**—Small, random exit holes made by insects
- **Sorrels**—Dead and dying trees that turn a red color

OBJECTIVE 2

List the effects of damage.

NOTE: Insects and diseases have destroyed more trees than forest fires. The destruction is not as dramatic as a forest fire because the effects are scattered—a single tree, a single stand. Occasionally tens and even thousands of acres can be infested and must be removed.

The effects of damage from insects, diseases, weather, wildlife and domestic animals, logging, air pollution, catastrophes, and other causes include:

- Reduced growth
- Damaged and deformed timber
- Seed and reproduction losses
- Lost revenues
- Time, manpower, money, and research invested in prevention and control

OBJECTIVE 3

Select from a list true statements about damage, disease, and insects.

- A single bark beetle can give birth to more than 10,000 offspring in a single summer, and each of these is a possible carrier of Dutch elm disease, fungi, nematodes, bacteria, or viruses.

- Most forest tree diseases are caused by fungi, which reproduce by spores. Perhaps you have stepped on a dry puffball mushroom, and have seen the spores as dust. The spores, plus bacteria and viruses, travel from tree to tree through the air with the wind, underground through the root systems, and are carried by animals, water runoff, truck tires, foresters' hands and boots, and, most commonly, by insects.

- Insects are present in the forest at all times. In ordinary circumstances there is a natural balance in which food supply, predators, and insect diseases keep the population under control. Healthy trees have their bark as a protective barrier and are genetically more or less resistant to certain insects and diseases.

- However, once an opening occurs in the bark, the tree is susceptible to insects and diseases. An opening in the bark can come from insects boring through the bark, from animals and insects peeling and eating it, from injuries caused by logging accidents or natural catastrophes such as ice, lightning, and fires. Drought, flood, and air pollution can weaken a tree so that it dies or loses its commercial value from infestation when, if healthy, it could have continued to grow.

Insect Damage

- A tree can seal its own wounds with resin if the wounds are small enough and left to heal, as when an increment borer is used. However, insects can loosen the outer bark and keep the tree from healing.

- Any opening in the bark is a doorway to insects and disease. Once a tree is infested, the surrounding trees are in danger of infestation.

  NOTE: Silvicultural practices are the main treatment for an infested area. Sometimes three or four acres will have to be cut to prevent the spread of disease and insects.

OBJECTIVE 4

Choose the word or phrase that completes statements about the type of injury caused by each class of insects. (Assignment Sheet 1, Supplements 1 and 2)

NOTE: Insects damage trees through their movement and feeding patterns.

- **Bark beetles**—Tunnel under the bark and chew into the stem through the cambium layer, destroying the phloem and cambium and girdling the tree. They introduce fungi that destroy the wood.

  INCLUDES: Southern pine beetle, Ips engraver beetle, black turpentine beetle

  NOTE: Bark beetles are the largest group of destructive insects that attack forest trees, causing about 60% of all tree deaths due to insect damage. (See Supplement 1)

- **Leaf eaters (also called defoliators)**—Destroy plant foliage by eating the leaves, stopping or slowing food production in the tree.

  INCLUDES: Forest tent caterpillars, Pine sawfly, bagworms

  NOTE: Caterpillars and other insects will eat the entire leaf; bagworms, sawflies, and others will skeletonize the leaves; leafminer larvae will suck the moisture out, leaving brittle brown or gray sections.

- **Sap suckers**—Feed by sucking the sap from trees. They rarely kill the tree but can slow its growth considerably.

  INCLUDES: Aphids, scales

- **Wood borers**—Bore into wood for food or shelter, destroying the fiber and carrying fungi or nematodes into the wood, causing it to rot. The fungi can also discolor or stain the wood, reducing its value.

  INCLUDES: Southern pine sawyer, ambrosia beetle, flatheaded wood borer, long-horned borers

- **Tip feeders (also called meristem feeders and terminal feeders)**—Eat the tips of the twigs, buds, and shoots. If damage is extensive the tree may die, but most damage is distorted growth and deformity, decreasing the commercial value of the wood.

  INCLUDES: Nantucket pine tip moth: attacks shortleaf and loblolly pines

- **Seed insects (cone borers)**—Deposit eggs in flowers or developing cones; the larvae eat the fruit, seeds, or nuts, which reduces plant reproduction.

  INCLUDES: Cone moths, cone beetles, acorn weevils, pecan weevils

- **Gall makers**—Damage the plant tissue so that the tissue swells abnormally; can affect the leaves, twigs, trunks, or roots; some gall-making mites cause gas formations.

  INCLUDES: Wasps, midges, aphids, mites

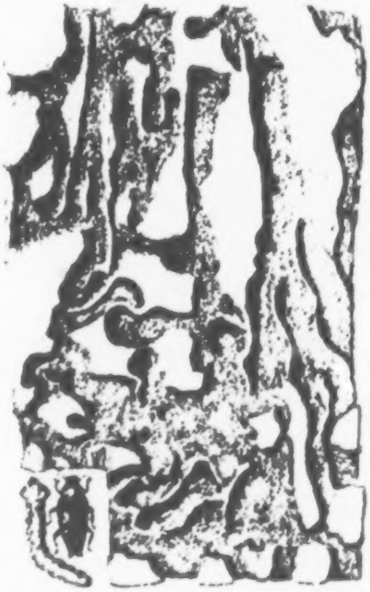
- **Root feeders**—Damage roots and interfere with nutrient absorption; can cause the death of all or part of the tree; some will also eat the bark of seedlings.

  INCLUDES: Most root feeders are beetle larvae, called white grubs; also wire worms.

OBJECTIVE 5

Name the class of insects according to symptoms of damage.
(Assignment Sheet 2)

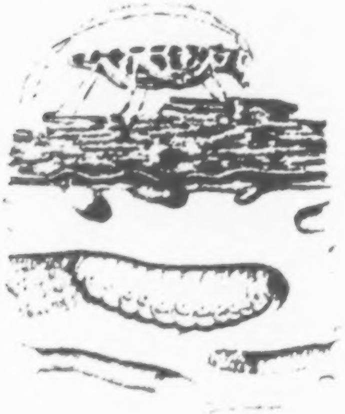
- Bark beetles



  - Pitch tubes
  - Galleries inside bark
  - Emergent holes
  - Wood with sap flow

Courtesy of Instructional Materials Service, Texas A & M University, College Station, Texas.

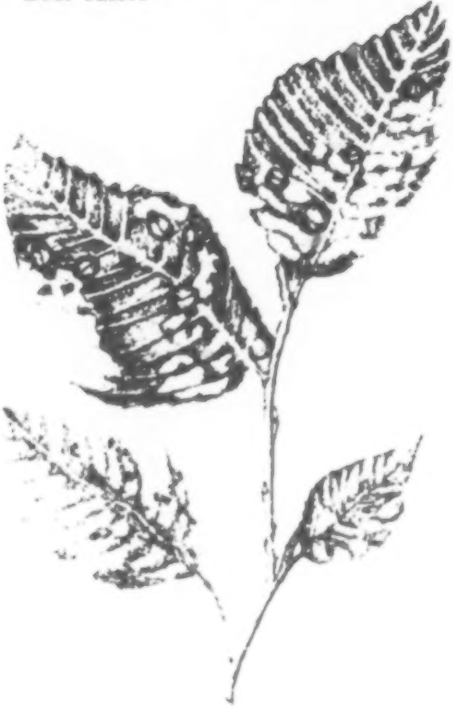
- Wood borers



  - White sawdust
  - Shot pattern

Courtesy of Instructional Materials Service, Texas A & M University, College Station, Texas.

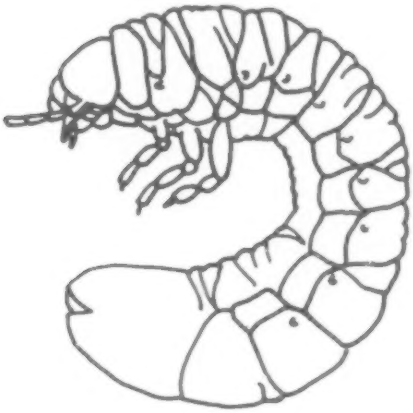
- Leaf eaters



  - Mining
  - Skeletonizing
  - Defoliating
  - Leaf curling

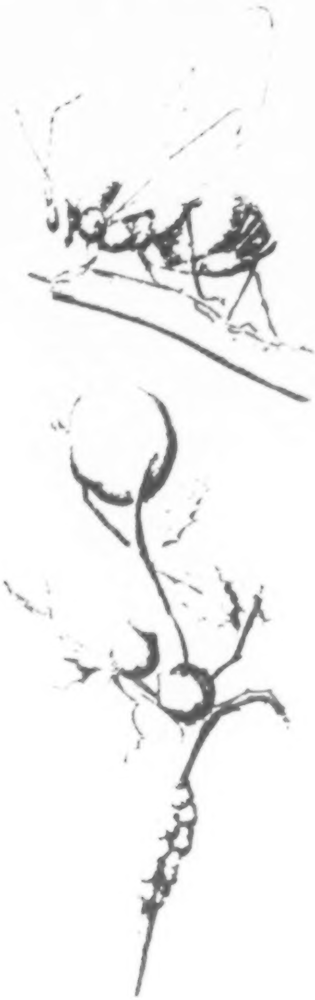
Courtesy of Instructional Materials Service, Texas A & M University, College Station, Texas.

- Root feeders



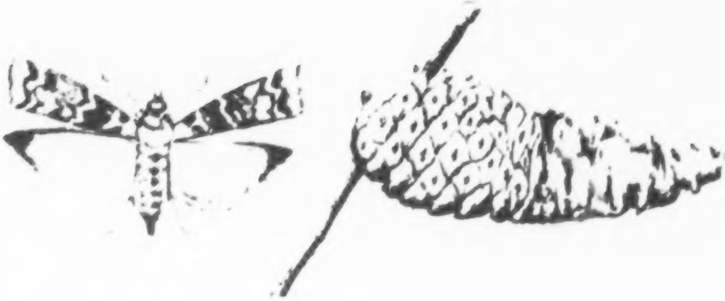
  - Wilting, eventual death
  - Death on one side of the plant with no apparent reason

- Gall makers
  - Swellings or galls



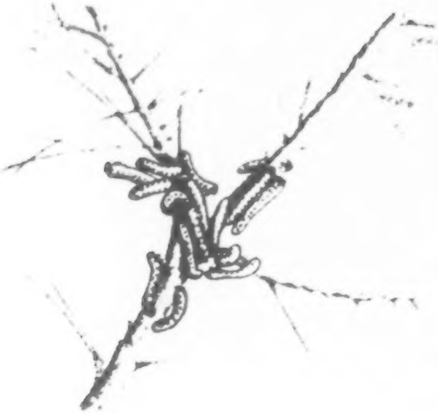
Courtesy of Instructional Materials Service, Texas A & M University, College Station, Texas.

- Seed insects
  - Hollow seeds and cones
  - Resinous flow from cones



Courtesy of Instructional Materials Service, Texas A & M University, College Station, Texas.

- Tip feeders
  - Flagging
  - Wilting



Courtesy of Instructional Materials Service, Texas A & M University, College Station, Texas.

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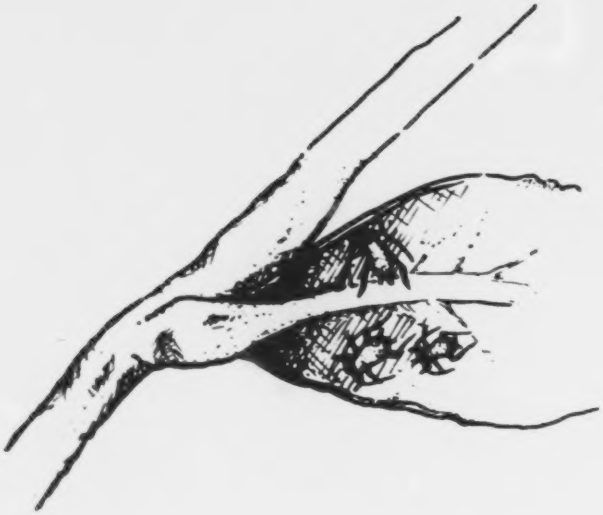
- Sap suckers
  - Necrotic spots or galls on leaves and twigs
  - Wilting



OBJECTIVE 6

Match common diseases of trees to their descriptions.
(Assignment Sheet 3)

Infectious diseases can spread throughout a stand. Diseases are caused by living organisms such as fungi, nematodes, bacteria, or virus. Saprophytic fungi, such as some mushrooms, mycorrhizae (my-kuh-RYE-zay—beneficial fungus on the roots), and bacteria are important in recycling nutrients in the forest ecosystem. But parasitic fungi that attack living trees cause the loss of more timber annually than forest fires.

The agent of the disease (a fungus, bacterium, or virus) usually is not visible, but the symptoms and signs of damage are easily recognized. A **symptom** is an evident reaction to disease, such as necrotic spots on leaves, rot, and changes in color of tissues. A **sign** is the actual fruiting body of the agent, such as mushrooms, conks, or mistletoe.

Symptoms

- **Cankers**—A symptom caused by various fungi or bacteria. Found in a wide variety of shapes and sizes, they all result in swollen, split, and distorted areas in the stem and branches.

  Common cankers inlcude Pine canker, Strumella canker, and Hispidus canker.

- **Leaf spots**—Leaf spots and other foliage diseases affect photosynthesis and, thus, plant growth and vigor. These symptoms can be caused by fungi, mites, air pollutants, bacteria, insects, nematodes and other agents. Generally, the disease agent damages or kills the plant by extracting nutrients from the leaves, resulting in necrotic spots or total necrosis (death of the leaf).

  Some leaf spot diseases are Anthracnose, leaf blister, powdery mildew, and needle blights such as brown spot needle blight.

- **Wood decay or wood rots**—Symptom caused by fungi which produce enzymes that digest the woody cell walls.

  NOTE: Decay can be caused by a variety of fungi, bacteria, and various environmental factors. There are several ways of describing the types of wood rots. One way is to divide it by the type of wood affected: living trees or wood products. Another common method of classifying wood rots is by the color of the residue.

  - **Heart rot**—Decay of living trees

  NOTE: Heart rots are classified as top rot, root rot, or butt rot, depending on which part of the tree is affected. About one third of all sawtimber losses are caused by heart rot, accounting for more loss than fire, insects, weather, or any other type of disease.

  - **Sap rot**—Decay of dead trees and wood products

  NOTE: Slash rot is a type of sap rot that attacks branches, stems, and roots of dead trees. It recycles minerals, carbon and other elements as the trees decompose. The second type, products decay, is responsible for deterioration in wood products, so that about ten percent of the yearly cut of timber is used as replacements.

- **White rot**—Fungi that digest only lignin or lignin and cellulose; the wood will be stringy or have small pockets of rot.

  NOTE: White rot leaves a white residue. They are most often associated with hardwoods, but not always.

- **Brown rot**—Fungi that digest only the cellulose; the wood will be stringy or have large pockets of rot and will often break into cubes when crushed in your hand.

  NOTE: Brown rot leaves a brown residue. They are often, but not always, associated with softwoods.

- **Dieback**—A wide variety of fungal organisms and stresses (drought, air pollution) can cause the branches to die at the tips; under severe conditions the dieback can progress back to the main stem or trunk.

  NOTE: Dieback organisms will produce small bumps or pimples on the dead branches.

- **Wilts**—Bacterial or fungal activity, drought, and other conditions can disrupt the constant (and critical) flow of water through the vascular system. At first, leaves become limp and droopy. Within a few days the leaf changes color to yellow-brown and dies. Eventually the branches die, and then the whole tree.

  Wilts include Dutch elm disease, oak wilt, and verticillium wilt.

- **Rusts or Gall Rusts**—A parasitic fungus that attacks pines, creating a canker or a gall, a wart-like growth on the trunks or branches. The canker or gall is especially visible in the early spring when the gall develops obvious orange or yellowish spores. Rusts can be either a symptom or a sign.

  NOTE: There are several types of rusts: Cottonwood rust with tiny orange and yellow pustules (like pimples) on the leaves, Eastern gall rust, Western gall rust, cedar apple rust that forms jelly-like tendrils, and fusiform rust, which is a major disease in loblolly and slash pine.

Signs

- **Conks or shelf fungi**—Indicate advanced decay of both sap rot and heart rot.

- **Mushrooms**—May indicate the presence of beneficial fungi, mycorrhiza or may indicate root rot.

  NOTE: Mycorrhizae are fungi that live on the feeder roots and act as organs for absorbing water and nutrients. Although the parasites feed on the root cells, their benefit to the plant is considered more important (a symbiotic relationship). They also help protect the tree from invasion by other root-disease agents.

- **Mistletoe**—A saprophytic plant that rarely kills its host but will stunt the growth in branches beyond the infection. The mistletoe plant causes swelling of the affected areas and the plant can shade tree leaves, resulting in dieback and decline.

  NOTE: Control is usually not needed in the southern forest. In the western conifer forest, the dwarf mistletoe is a serious disease, killing many trees and stunting and deforming those not killed. When dwarf mistletoe seeds ripen, they explode out of the casing, shooting 60 feet or more. The seeds are sticky and will cling to new hosts, starting new plants. In heavily infested stands, clearcutting is often the only solution.

OBJECTIVE 7

Select from a list true statements about methods of insect control and prevention.

Protection against insects and diseases employs the same basic methods, especially since diseases are often spread by insects.

Controls

- **Direct controls**—Those methods of insect or disease control that attack the specific pest or disease.

  EXAMPLES: Traps, chemicals

- **Indirect controls**—Methods that control insects or diseases by affecting their environment, food supply, reproductive cycles, etc. through forest management practices.

  EXAMPLES: Natural, biological, IPM (Integrated Pest Management), and silvicultural controls (See following page)

- **Natural controls**—Extreme high or low temperatures reduce insect activity or kill insects; severe rainstorms will wash leaf-eaters and sap suckers off the foliage; natural enemies such as birds, mice, and beneficial insects feed on destructive species; diseases that attack harmful insects, tree vigor, and competition for food and space are also factors of natural control.

  EXAMPLES: Checkered beetles, southern pine sawyers, ostomid beetles, ants, and woodpeckers are natural predators of bark beetles and help keep them under control.

- **Silvicultural controls**—Intensive forest management to regulate conditions so that a natural balance is maintained between the destructive insects and their natural enemies, between the insects and their food supply, and between disease and insects.

  Silvicultural practices can create unfavorable conditions for insect development and can help trees improve resistance to insect and disease attack.

  EXAMPLE: Cutting and removing infested or susceptible trees to stop the spread of insects

- **Chemical controls**—Insecticides are used when other methods fail, such as when a localized epidemic must be stopped before severe, large-scale damage occurs.

  — Chemical controls are of three main types:

  Contact poisons - Kill insects on contact with their skin, as when trees are sprayed with insecticides.

  Stomach poisons - Kill insects when eaten; they are applied to the roots, under the bark or injected into the tree and taken up into the leaves; particularly effective for leaf-eaters and sap suckers.

  Fumigants - Kill insects when they breathe the poison; most useful against insects hidden in the wood or in the soil.

  — Many insecticides have a combination of these properties and are effective against several types of insects.

  — Pesticides are applied to single trees and small areas with hand-pumped pressurized sprayers. Large areas are treated by aerial spraying at low altitudes with airplanes or helicopters.

- All chemical controls are strictly regulated by the Environmental Protection Agency (EPA).

- **Biological controls**—Improve the impact of predators, parasites and insect diseases by introducing sterile insects, increased predator populations, bacteria, and viruses to control specific, harmful pests.

  EXAMPLES: Ladybugs, Praying Mantis, certain species of nematodes, trichogamma wasps, green lacewings, fly parasites

- **IPM (Integrated pest management)**—Coordinated use of silvicultural, biological, and chemical controls so they work together to control insects and minimize harmful effects to the environment and forest or to the animal and human populations.

Prevention

- Eliminate situations that are favorable to insects such as unhealthy conditions in the forest: overcrowding, careless logging, poor forest management.

- Encourage conditions unfavorable to insects through:

  - Removing susceptible trees and regulating the density and composition with improvement or salvage cuts and thinnings.
  - Regulating environmental factors through draining and density.
  - Selecting insect-resistant or disease-resistant varieties and species of trees.
  - Careful seed selection.
  - Site selection.
  - Adjusting cutting cycles and methods.
  - Rotating crops.

OBJECTIVE 8

Describe types of weather damage.

Most species of trees can withstand normal changes in temperature, moisture, winds, etc. But severe weather conditions can cause serious damage to single trees or to extensive forested areas.

Again, the best protection is intensive forest management, particularly thinning practices and immediate salvage harvest following bad weather. Dead or dying timber creates a fire hazard and provides a breeding ground for insects and diseases.

- **Drought** is a prolonged dry period when soil moisture is so low that tree growth slows or stops until there is sufficient moisture or until the tree dies.
- **High temperatures** (above 120-130° F, 49-54° C) can cause the death of seedlings.
- **Scald** overheats and damages the cambium tissue, causing permanent wilting in young leaves and in southern trees with thin barks.

  NOTE: Sunscald is a serious problem on fruit trees. The greatest damage occurs on the southwest side of the tree. A canker will grow and envelope the tree. Damage can be prevented by wrapping stems on younger trees.
- **High winds**, such as hurricanes or tornadoes, damage both softwoods and hardwoods, particularly in overcut pine stands. Young and mature trees are uprooted and windthrown. If not removed, there is no reproduction under the felled trees.
- **Ice** does the most serious damage. Young, even-aged stands suffer the most damage because the interlacing branches hold large quantities of glaze ice and snow. Trees can be crushed, bent to the ground, and trunks or crowns can be permanently twisted.
- **Severe hail** can knock down limbs and trees, and can completely defoliate limbs and leaders.
- **Freezing** can kill seedlings outright (called winterkill) or cause cankers. Large trees can be winterkilled if the buds or leaves are destroyed by heavy frosts in early fall or late spring.
- **Flooding** will damage trees if the water stands for a prolonged period.

- **Lightning** generally hits the tallest and best trees in the stand. If the tree is not killed outright, damage to the bark leaves them open to insects and diseases.

OBJECTIVE 9

Match animals to descriptions of damage.

NOTE: Not all animals are destructive. Birds help control insects and skunks consume grubs. Regulated wild and domestic browsing gets rid of potential fire hazards such as grass and light brush; sheep and goats will clear unwanted hardwoods out of softwood stands.

Wild animals

- **Browsers**—Elk, moose, and deer become a problem when they overbrowse; usually caused by overpopulation; they nip off the leaders, causing slow or stunted growth; they rub the velvet from their antlers against the bark, leaving open wounds for insects and diseases to enter the tree

  NOTE: Moose can browse as high as 11 feet above the ground. Elk have seriously impaired reproduction in the western forests, and deer have been known to eat entire crops of acorns, preventing new growth. In some areas, there are no trees under 30 years old because of overbrowsing deer.

- **Rabbits**—Eat the young shoots of trees, resulting in dead or deformed trees

- **Porcupines**—Eat the bark from trees, girdling them; if the tree is not killed, it is wounded and susceptible to insects and diseases

  NOTE: Porcupines' only natural enemy is forest fires. Now that wildfires have been reduced and contained, porcupines have become a serious menace in the northwest, Great Lakes, and New England regions.

- **Beavers**—Fell small pole-sized trees for food, housing, and dam construction; cause the most amount of damage

- **Rodents**—Squirrels, chipmunks, and white-footed mice eat seeds, seriously damaging seed crops and reducing reproduction

- **Gophers**—Eat roots, especially in machine-planted plantations; can eradicate an entire plantation

- **Bears**—Remove the bark to eat the cambium, a major part of their diet

- **Elephants**—Will push over, break, and uproot trees in tropical forests to get to the foliage and twigs; or will debark and delimb trees too large to push over

  NOTE: In countries where elephants are a problem, tourist revenue is often created by wildlife, and loss of the forest becomes a secondary concern, so there is no effort to control the damage.

Domestic animals

- **Grazers**—Sheep, cattle, and horses eat and trample on seedlings, eat young roots for the moisture; trample grass so the ground becomes compacted, exposed and subject to erosion; exposed and wounded roots can dry out and attract insects and diseases

  NOTE: Cattle create severe compaction problems.

- **Hogs**—Cause intense damage by trampling and compacting the ground; digging and rooting in the soil; eating acorns and seeds; they destroy great numbers of seedlings by eating the roots

OBJECTIVE 10

Complete statements about methods of animal control.

NOTE: State laws encourage and govern hunting and fishing to preserve the balance of wildlife, habitat, and food supply. Trapping, poisoning, and fencing have not proven effective (except with gophers). As with other methods of damage control, good forest management is the best approach. It includes practices that will improve the forest for wildlife and at the same time protect the forest crop from damage and destruction from wildlife. Because weather cycles are critical to wildlife survival and feeding patterns, timing is very important.

- The most effective method for controlling domestic grazing is to graze only the numbers and types of animals that will maintain a desirable balance in the ecosystem, removing unwanted grass, brush, and seedlings, and leaving bark, roots, seeds, and leaves of desirable trees. Fences, although expensive, can keep wildlife and domestic animals out of farm woodlots, but they are not a good solution for large forested areas.

  NOTE: If cattle have proper nutrients in their diet, they won't eat tree needles.

- Where there are many deer or other browsers, logging, stand improvement, or thinning activities can be scheduled for mid- or late winter when the animals are most in need of food and can browse on tops and limbs.

- Small ponds can be built to hold back seepage or runoff water from slopes in places where there are long distances between sources of water. Increasing the available water supply enables wildlife to spread out through the forest and increases the range for many species.

- Food supply can be increased by planting game food mixtures along logging roads and in planned patches and by clear-cutting small openings and planting berries and legumes.

OBJECTIVE 11 **Choose the best word or phrase to complete statements about air pollution and other damage.**

- **Air pollution**—Trees can be injured by gases and particles in the air that are absorbed in the process of photosynthesis. Industrial wastes such as sulfur dioxide, chlorine, fluoride, and ozone are known to damage trees. Some trees absorb and use these pollutants with no apparent harm, while others die. Scientists believe that a combination of factors such as host and environment play a part in whether a tree dies or survives.
  - The needles of conifers suffer the most damage because the absorption usually occurs through the leaves. Needles will drop prematurely and trees cannot maintain needed food production levels. Trees die because they are weakened by undernourishment and become susceptible to disease, insect attack, and environmental stresses.
  - Damage to hardwoods is less severe because they lose their leaves for part of the year and replace them with new, undamaged, leaves the following year.
  - Acid rain and pollutants carried by wind or rain can burn foliage which settles on the ground and acidifies the soil, damaging trees and other vegetation.
  - Toxic wastes from landfills and mines can pollute the soil and groundwater.

- Damage to the forest also comes from:
  - Improper nutrition that affects growth rate, seed production, foliage, and resistance to disease and insects.
  - Road salt that blows onto trees or dissolves in water and is thrown onto foliage by passing vehicles.
  - Ocean spray and sea salt are a problem in coastal areas, affecting foliage, soil, and water.
  - Catastrophes such as earthquakes, tornados, hurricanes, volcanoes and tidal waves that create extreme environmental imbalances; earthquakes and volcanos are frequently accompanied by fires.

OBJECTIVE 12 **Select from a list true statements about logging damage.**

- Some damage is inevitable in any logging operation. Foresters must make a conscious effort to prevent and minimize the damage to the trees left standing. Caution is important for the sake of the forest and to protect the remaining timber from unnecessary damage that will lower its commercial value.
- The major damages are wounds that leave exposed wood, which attracts wood-rotting fungi, and the loss of regeneration in logging areas.

Damage during felling

- When a tree is selected for harvesting there may be other trees that (1) hinder getting to the selected tree, (2) are in the fall line, or (3) in the removal path. These other trees often are cut, broken, crushed, or have the bark scraped off during logging.

  NOTE: The greatest destruction of growing stock is likely to occur in uneven-aged stands with large seedlings and small saplings that are tall enough to hinder operations but not durable enough to resist breakage.

- Trees are sometimes pushed into a leaning position against other trees to enable equipment to pass or to allow a tree to fall to the ground without snagging in a standing tree. The place where the trees rub together forms an undesirable reaction wound, like a callous on human skin. This practice can be more damaging than killing the tree because the tree can lose its commercial value, while taking up growing space.

Equipment damage

- Standing trees are wounded during felling and skidding.

  NOTE: Tow chains wrap around a tree or several trees and gouge or scrape the bark as they pull across the trunk.

- Equipment operating on the forest floor cuts, scrapes, and crushes roots.

- Equipment compacts the soil, and can cause major damage.

- Building roads compacts soil and destroys root systems. If roads are not properly constructed and maintained, erosion can occur.

  NOTE: The greatest amount of sediment runoff is from the road, not from the forest land itself. If not channeled properly with culverts and laid out on the contour, roads can be a major factor in erosion. Logging companies usually seed the roads to control erosion when logging in an area is completed.

- Logging debris deposited in streams or bodies of water can impair the water quality, harming fish and wildlife.

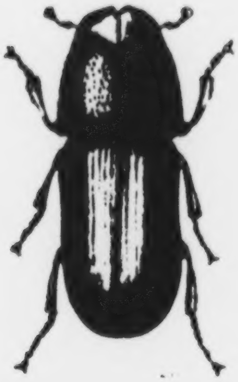
BARK BEETLES

Bark beetles are the largest group of destructive insects that attack forest trees, causing about 60% of all tree deaths due to insect damage.

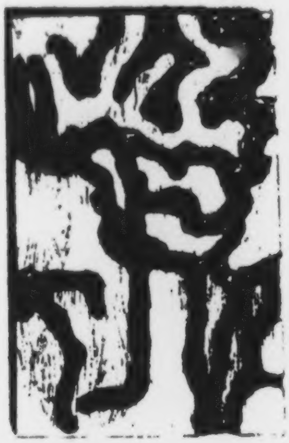
Bark beetles increase in population and activity following ice, hail, or wind storms; intense fires; extended droughts; and other major forest disturbances.

Southern pine beetle

Color:	Brown to black in color
Size:	Smaller than a grain of rice
Comment:	From an economic standpoint, the southern pine beetle is the most important forest insect.



Adult



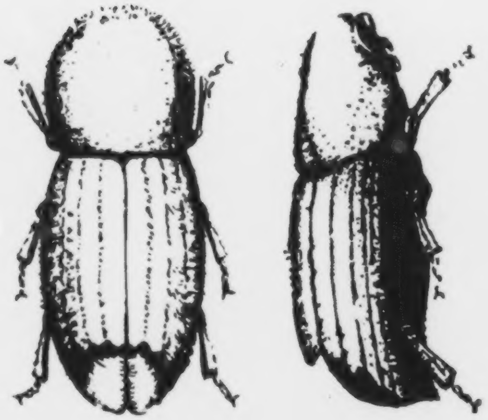
S-Shaped Galleries

Courtesy of Instructional Materials Service, Texas A & M University, College Station, Texas.

Detection: Tree crowns turn grayish-yellow to reddish-brown. Dime-size pitch tubes appear on the trunk, or reddish boring dust may be lodged in the bark crevices and around the base of the trees. Tunnels are S-shaped.

Ips engraver beetle

Color:	Tan to rich brown
Size:	1/8 inch to 1/4 inch
Comment:	The rear of the body is shovel-shaped rather than squarish. There are three distinct species, distinguishable by their sizes. The smallest Ips prefer the twigs and branches of the upper crown, the medium-sized Ips settle in the middle trunk and lower limbs; and the large species attack the lower portion of the tree.



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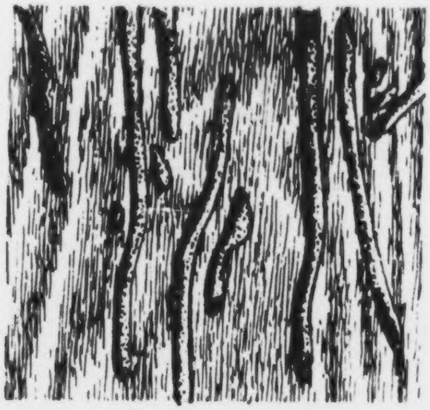


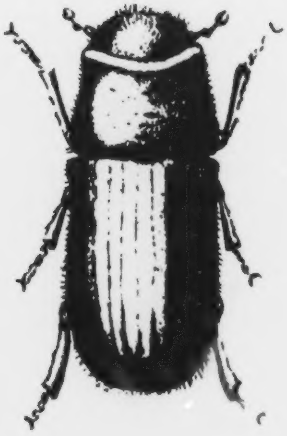
J-Shaped Tunnels

Courtesy of Instructional Materials Service, Texas A & M University, College Station, Texas.

Detection:	Pitch tubes are dime-sized or smaller with reddish boring dust. Tunnels are almost straight up and down under the bark. Ips beetles are found in injured trees (lightning-struck pines, logging tops), overmature trees, or dying pines.

Black turpentine beetle

Color:	Older adults are usually black
Size:	1/4 to 1/2 inch in length
Comment:	Largest bark beetle. The parent beetles build broad, winding tunnels and deposit the eggs in masses along the sides. When the grubs hatch, they feed in groups, destroying irregular patches of wood tissue under the bark.



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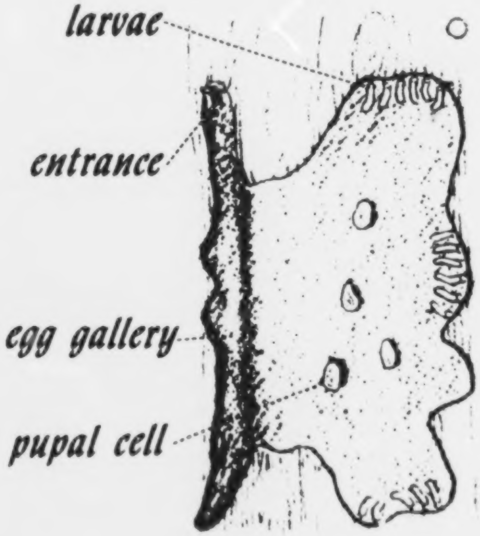

Excavation Pattern

Courtesy of Instructional Materials Service, Texas A & M University, College Station, Texas.

Detection:	Pitch tubes have a thumb-like appearance and sugary texture occurring singly on a tree or in numbers around the trunk. Coarse particles of hard resin are pushed out of the pitch tubes and build up in piles at the base of the tree. Grubs are easily identified: they are white and feed side by side in groups. The turpentine beetle attacks the lower trunk and larger roots of live pines and recently-cut stumps.

COMMON INSECTS AFFECTING PINE AND HARDWOOD TREES IN SOUTHERN FORESTS

Defoliators	Bark Beetles and Borers	Tip Feeders	Sapsucking Insects
CONIFER INSECTS			
Arkansas pine sawfly Bagworm Pine colaspis Pine sawfly Pine webworm Redheaded pine sawfly Texas leaf cutting ant Virginia Pine Sawfly	Ambrosia beetle Black turpentine beetle *Ips* engraver beetle Southern pine beetle Southern Pine sawyer	Coneworms Deodar weevil Nantucket pine tip moth Pales weevil Pine seedworms Pitch eating weevil White pine beetle	Balsam wooly aphid
HARDWOOD INSECTS			
Looper Cottonwood leaf beetle Eastern tent caterpillar Elm spanworm Fall cankerworm Fall webworm Forest tent caterpillar Gypsy moth Locust leaf miner Oak leaf tier Variable oakleaf caterpillar Walkingstick	Carpenter worm Columbian timber beetle Cottonwood borer Cottonwood twig borer Hickory bark beetle Red oak borer Smaller European elm bark beetle White oak borer		Beech blight aphid Red spider mites Sycamore lace bug White flies

Adapted from U.S. Forest Service publication, *Insects and Diseases of Trees in the South.*

ASSIGNMENT SHEET 1

IDENTIFY TYPES OF FOREST DAMAGE

XV

NAME ______________________________ SCORE _______

OBJECTIVE 13

Identify insects from a description of damage.

INTRODUCTION

Prompt identification and treatment of pests and diseases can make the difference between saving or losing a valuable shade tree or a valuable commercial stand. Keeping trees healthy and growing vigorously is the first step in prevention. Identifying insects and identifying injury is the first step in treatment.

DIRECTIONS

Use the information in Objectives 4 and 5 and in Supplements 1 and 2 to identify the insects and insect classes below.

1. Large holes are eaten in the leaves of an oak.

    a. What class of insect did the damage? ________________

    b. What effect will it probably have on the tree? __________

    ____

2. There's a problem with a shortleaf pine. Sam sees pitch tubes at breast height a little bigger than a shirt button. There is red dust lying around the base. He finds brown beetles crawling on the bark, which is loose. He takes out his pocket knife and pulls the loose bark away.

    a. Are the beetles small or large? ____________________

    b. What does he see when he pulls away the bark? ________

    ____

3. A section of bark about 2 ft x 1 1/2 ft has fallen from a loblolly pine. The inner bark has so many S-shaped galleries, it looks like an abstract painting.

    a. What insect are you looking for? ___________________

    b. What other signs should be present to help you identify the insect? ______________________________________

    ____

    ____

4. You find a large rotted Southern yellow pine. At the base of the tree is a pile of white sawdust about two inches deep.

   a. Where will you find the insect? ____________________

   b. What might have caused the rot? ____________________

   c. What other sign might be present? ____________________

5. As you drive along the highway, you see large, silken webs or tents in the pines made by the pine webworm. You go up to the tree and look inside the webs. What part of the tree has been damaged?

   ____

6. Tony and Linda have a row of beautiful Scotch pine trees lining the driveway. Three of the trees have sections that are wilted. What classes of insects might possibly be involved?

   ____

   NOTE: Soil compaction on the driveway could have caused these same symptoms.

7. Harvey's dad has a stand of oak. Last year, in the spring, the leaves turned a light color. This year Harvey checks the stand more closely and finds he can see through spots on the leaves and sometimes the whole leaf is dead. Some twigs have small galls on them. What class of insects should he look for?

   ____

8. Your little sister comes in with her latest "treasure," a twig with three of what she calls "magic balls." You tell her the balls were made by insects she sees all summer. What are the insects?

   ____

9. She picks up a pine cone with "sticky stuff" all over it.

    a. What class of insect is associated with the "sticky stuff?"

    ____

    b. What can you predict for the stand if the infestation is allowed to spread? ______________

10. According to the chart in Supplement 2, what class of insects contains the most species?

    ____

11. According to the chart in Supplement 2, what class attacks pines only?

    ____

ASSIGNMENT SHEET 2

IDENTIFY TYPES OF FOREST DAMAGE

XV

NAME ______________________________ SCORE ______

OBJECTIVE 14

Identify insect damage from collected samples.

INTRODUCTION

Collecting samples is easy and fun and is a good way to learn about insects. There are a number of ways you can make your collection:

- Take physical samples and mount them on sheets of paper or cardboard in a notebook or in boxes
- Take photographs of insect damage and mount them in a notebook
- Make detailed descriptions of what you find, perhaps with drawings, like a scientist, and keep them in a notebook

DIRECTIONS

Make a collection of insect damage. Be sure your project is neat and arranged in a logical order. Include the following information:

- Identify each type
- Label them if you have pictures or samples
- Briefly describe the conditions and circumstances in which you found it:
  - Tree species
  - Location on the tree
  - Condition of the tree
  - Other unusual circumstances

Hand in the finished project to your teacher by the assigned date.

ASSIGNMENT SHEET 3

IDENTIFY TYPES OF FOREST DAMAGE

XV

NAME ______________________________ SCORE ________

OBJECTIVE 15

Make a chart of major tree diseases.

INTRODUCTION

Diseases are silent killers. As with humans, a tree may live for years with a disease, it may become weak or deformed, or it may die within a short time of infection. You know that disease can be caused by viruses, fungi, bacteria, mold and parasitic insects and plants and by factors such as weather, air pollution, and poor soil conditions.

Our modern world with its advanced technology injures trees and forests with its equipment and carelessness. Chemicals, too, are becoming a serious problem. Chemical spills and industrial waste have caused large losses in localized areas. Pesticides, herbicides, ozone, sulfur dioxide, fluoride, and ammonia are the major concerns. Diagnosis is complex, and the only control is protection from exposure.

DIRECTIONS

Using the information in Objective 6 make a chart of major tree diseases.

Diseases are classified into three types: Foliage diseases, stem diseases and rotting diseases. In forest trees, foliage diseases reduce the growth rate but rarely kill trees. Stem diseases, however, can cause severe epidemics that result in widespread losses. Stem diseases fall into three categories: cankers, rusts, and wilts. Make a chart of the diseases in the Information Sheet. Do not include the saprophyte mistletoe.

Types of diseases

Foliage & Twigs	Stem			Root
	Cankers	Rusts	Wilts	

ASSIGNMENT SHEET 4

IDENTIFY TYPES OF FOREST DAMAGE

XV

NAME ______________________________ SCORE _______

OBJECTIVE 16

Report on damage from natural and manmade causes.

INTRODUCTION

There is no substitute for experience. The best way to learn about insect, disease, and other types of damage is to go into the forest and look for yourself. You'll see many kinds of injury and damage and you'll find that you now have the resources and the knowledge to recognize some of them.

Look all around. Notice the adjacent trees, the soil, the brush, the regeneration, the age of the stand, the amount of rotted wood on the forest floor, signs of wildlife, and signs of logging activity.

DIRECTIONS

1. Go into the forest, especially in an area that has had some logging activity, and look for different types of forest damage. Take a notebook and record your observations. Use a separate page for each observation so you can make notes and comparisons later.

   Include at least:

   - Location of the area you are studying
   - Type of damage
   - Species of tree
   - Possible cause of the damage
   - Condition of the tree
   - Any other observations

2. Summarize your findings into a brief, well-organized report. Share your report with the class in a short oral report, not to exceed three minutes.

ASSIGNMENT ANSWERS

IDENTIFY TYPES OF FOREST DAMAGE

XV

ASSIGNMENT SHEET 1

1. a. Leaf eater (defoliator)
   b. Slow its growth
2. a. Large
   b. J-shaped galleries
3. a. Southern pine beetle
   b. Crown turns grayish-yellow to reddish brown, dime-size pitch tubes, reddish boring dust
4. a. In the wood (borer)
   b. Fungus or nematodes
   c. Shot pattern
5. Needles
6. Tip feeders, sap suckers, root feeders
7. Leaf eaters (defoliators)
8. Wasps
9. a. Seed insects
   b. Poor regeneration
10. Defoliators (leaf eaters)
11. Tip feeders (meristem feeders)

ASSIGNMENT SHEET 2

Check that student:

- Identified each type
- Labeled them if pictures or samples were used
- Briefly described the conditions and circumstances in which he or she found it:
  - Tree species
  - Location on the tree
  - Condition of the tree
  - Other unusual circumstances
- Evaluate neatness.

ASSIGNMENT SHEET 3

Types of diseases

Foliage & Twigs	Stem			Root
	Cankers	Rusts	Wilts	
Anthracnose	Pine canker	Gall Rust	Oak wilt	Annosus root rot
Leaf blister	Strumella canker		Dutch elm disease	Wood rots
Brown spot needle blight	Hispidus canker			
Powdery mildew			Verticillium wilt	

ASSIGNMENT SHEET 4

1. Check that students included:

   - Location of the area you are studying
   - Type of damage
   - Species of tree
   - Possible cause of the damage
   - Condition of the tree
   - Any other observations

2. Class report was clearly organized, delivered with confidence, and did not exceed three minutes.

WRITTEN TEST

IDENTIFY TYPES OF FOREST DAMAGE

XV

NAME ______________________________ SCORE _______

OBJECTIVE 1

Match terms associated with insects, diseases, and natural damage to their correct definitions.

____ 1. Abnormal growth that often serves as a nest or burrow for larvae

____ 2. Any undesirable or destructive organism

____ 3. Areas of dead tissue

____ 4. Dead and dying trees that turn a red color

____ 5. Dying of branch tips

____ 6. Organisms which exist by consuming other organisms

____ 7. Live on dead and decaying matter, breaking down trees and plants into soil

____ 8. Rain freezes as it falls, coating branches, leaves, and limbs with a heavy layer of ice

____ 9. Small, random exit holes made by insects

___ 10. Protruding wounds like warts caused by disease, insect damage, or injury

___ 11. Live on or in another organism, taking nutrients or protection without compensation

___ 12. Rapid, explosive increase of an insect population or the rapid spread of disease

___ 13. Holes in the bark at the point where insects have entered the tree

___ 14. To eat all but the veins of leaves

___ 15. To eat only the inside tissue of leaves

___ 16. To eat the entire leaf

a. Cankers

b. Carnivores

c. Contagious disease

d. Epidemic

e. Flagging

f. Gall

g. Glaze ice

h. Hail

i. Infectious disease

j. Necrotic spots

k. Parasitic organisms

l. Pest

m. Predators

n. Saprophytic organisms

o. Shot pattern

p. Sorrels

q. Symbiotic organisms

r. Tip death

s. Defoliate

t. Galleries

u. Host

v. Larvae

___17. Tunnels formed by insects chewing through the inner bark

___18. A wormlike immature insect, such as a caterpillar

___19. A tree or other organism in which a parasite lives

w. Mine
x. Pitch tubes
y. Pockets
z. Pupa
aa. Sapsucking
bb. Skeletonize
cc. Strip

OBJECTIVE 2 **List the effects of damage.**

____

____

____

____

____

____

____

OBJECTIVE 3 **Select from a list true statements about damage, disease, and insects.**

____ 1. A single bark beetle can give birth to more than 10,000 offspring in a single summer.

____ 2. Most forest tree diseases are caused by fungi.

____ 3. An infested tree does not endanger surrounding trees.

____ 4. Fungi reproduce by spores.

____ 5. A tree cannot seal its own wounds with resin even if the wounds are small.

____ 6. Spores can only be transported from tree to tree through the air with the wind.

____ 7. Any opening in the bark is a doorway to insects and disease.

____ 8. Healthy trees have their bark as a protective barrier and are genetically more or less resistant to certain insects and diseases.

____ 9. Air pollution is not a threat to trees.

___ 10. Spores are most commonly transported by insects.

OBJECTIVE 4

Choose the word or phrase that completes statements about the type of injury caused by each class of insects. Write the correct letters in the blank.

____ 1. Sap suckers feed by sucking the sap from trees. They______ .

a. always kill the tree
b. rarely kill the tree, but can slow its growth
c. never kill the tree, but can slow its growth
d. rarely cause significant damage

____ 2. Bark beetles tunnel under the bark and chew the _______ .

a. leaves
b. roots
c. stem
d. buds

____ 3. Wasps, midges, aphids, and mites are ________ .

a. seed insects
b. wood borers
c. leaf eaters
d. gall makers

____ 4. Tip feeders are also called terminal feeders and _______ .

a. meristem feeders
b. bud feeders
c. grubs
d. pine beetles

____ 5. When defoliators eat the leaves they _______ .

a. kill the tree in a single season
b. stop or slow down food production
c. infest the tree with bacterial disease
d. destroy the wood

____ 6. Most damage caused by tip feeders is ______ .

a. distorted growth and deformity
b. loss of protective bark
c. fungal, and therefore, minimal
d. transferred to the root system

____ 7. Pecan weevils, acorn weevils, cone beetles and cone moths are _______ .

a. tip feeders
b. wood borers
c. defoliators
d. seed insects

____ 8. Root feeders damage roots and iterfere with nutrient absorption. They _______ .

a. always kill the tree
b. can kill part of all of the tree
c. rarely kill the tree
d. rarely cause significant damage

____ 9. Wood borers cause the wood to rot because they destroy the fiber and _______ .

a. deposit eggs in the flowers or cones
b. eat the bark of seedlings
c. carry fungi into the wood
d. cause gas formations

___ 10. Bark beetles destroy the _______ .

a. xylem and phloem
b. cambium and phleom
c. cambium and heart
d. cambium and xylem

___ 11. Aphids and scales are _______ .

a. sap suckers
b. leaf eaters
c. tip feeders
d. root feeders

___ 12. The insects that girdle the tree are ______ .

a. Southern pine beetle, Ips engraver beetle, black turpentine beetle
b. forest tent caterpillars, pine sawfly, bagworms
c. ambrosia beetle, Southern pine sawyer, long-horned borer
d. wasps, midges, aphids, mites

OBJECTIVE 5

Name the class of insects according to symptoms of damage. Write the name of the classes in the blanks. Answers may be used more than once.

________________________ 1. Flagging
Wilting

________________________ 2. Emergent holes
Wood with sap flow

________________________ 3. Hollow seeds and cones
Resinous flow from cones

________________________ 4. Necrotic spots or galls on leaves and twigs
Wilting

________________________ 5. Mining
Skeletonizing
Defoliating

________________________ 6. White sawdust
Shot pattern

________________________ 7. Wilting, eventual death
Death on one side of the plant with no apparent reason

________________________ 8. Pitch tubes
Galleries inside bark

________________________ 9. Swellings or galls

________________________ 10. Leaf curling

OBJECTIVE 6

Match common diseases of trees to their descriptions. Write the correct letters in the blanks.

____1. Symptom caused by various fungi or bacteria. Found in a wide variety of shapes and sizes, they all result in swollen, split, and distorted areas in the stem and branches.

____2. Sign that may indicate the presence of beneficial fungus, mycorrhiza, or may indicate root rot.

____3. Sign that indicates advanced decay of both sap rot and heart rot.

____4. Symptoms that affect photosynthesis; generally, the disease agent damages or kills the plant by extracting nutrients from the leaves, resulting in necrotic spots or total necrosis.

____5. Saprophytic plant that rarely kills its host but will stunt the growth in branches beyond the infection. This sign causes swelling of the affected areas and can shade tree leaves, resulting in dieback and decline.

____6. Symptom in which bacterial or fungal activity, drought and other conditions can disrupt the constant flow of water through the vascular system. At first, leaves become limp and droopy. Within a few days the leaf changes color to yellow-brown and dies. Eventually the branches die, and then the whole tree.

____7. Symptom caused by fungi which produce enzymes that digest the woody cell walls.

____8. Parasitic fungus that attacks pines, creating a wart-like growth on the trunks or branches. Especially visible in the early spring when it develops obvious orange or yellowish spores. May be a symptom or a sign.

____9. Symptom in which a wide variety of fungal organisms and stresses (drought, air pollution) can cause the branches to die at the tips; under severe conditions the symptom can progress back to the main stem or trunk.

a. Mushrooms
b. Warts
c. Wilts
d. Dieback
e. Cankers
f. Root fungi
g. Mistletoe
h. Conks or shelf fungi
i. Moss
j. Leaf spots
k. Rusts or Gall Rusts
l. Leaf fungi
m. Wood decay or wood rots

OBJECTIVE 7

Select from a list true statements about methods of insect control and prevention. Write an "X" in the blank before each true statement.

____ 1. Chemical controls are used when other methods fail, such as when a localized epidemic must be stopped before severe, large-scale damage occurs.

____ 2. If foresters release a population of 150,000 pecan weevils infected with a lethal virus, they are using biological controls.

____ 3. Silvicultural control works through intensive forest management to regulate conditions so that a natural balance is maintained between the destructive insects and their natural enemies, between the insects and their food supply, and between disease and insects.

____ 4. Pesticides that will kill a variety of insects are considered indirect controls.

____ 5. Careful seed selection is considered prevention.

____ 6. Fumigants are applied to the bark or roots.

____ 7. A chipmunk digging and eating grubs is considered a natural control.

____ 8. Contact poisons are particularly effective on wood borers.

____ 9. Tree vigor and competition for food and space are considered biological controls.

____ 10. Prevention seeks to eliminate situations that are favorable to insects and encourage conditions unfavorable to them.

____ 11. IPM (Integrated Pest Management) is the coordinated use of silvicultural, biological, and chemical controls so they work together to control insects and minimize harmful effects to the environment and forest or to the animal and human populations

____ 12. Stomach poisons are particularly effective for leaf-eaters and sap suckers.

____ 13. Silvicultural practices can create unfavorable conditions for insect development and can help trees improve resistance to insect and disease attack.

____ 14. Silviculture is a direct control for insects and their predators.

____ 15. If 100,000 lady bugs are imported into a stand of seedlings to eat aphids, it is considered a natural control.

OBJECTIVE 8

Describe types of weather damage. Describe seven types of weather damage.

OBJECTIVE 9

Match animals to descriptions of damage. Write the correct letters in the blanks.

____ 1. Fell small pole-sized trees for food, housing and dam construction; cause the greatest amount of damage

____ 2. Will push over, break, and uproot trees in tropical forests to get to the foliage and twigs; or will debark and delimb trees too large to push over

____ 3. Cause intense damage by trampling and compacting the ground; digging and rooting in the soil; eating acorns and seeds; destroy great numbers of seedlings by eating the roots

____ 4. Eat the bark from trees, girdling them; if the tree is not killed, it is wounded and susceptible to insects and diseases

____ 5. Overbrowse, usually due to overpopulation. They nip off the leaders, causing slow or stunted growth; they rub the velvet from their antlers against the bark, leaving open wounds for insects and diseases to enter the tree

____ 6. Eat the young shoots of trees, resulting in dead or deformed trees

____ 7. Trample on seedlings, eat young roots for the moisture; trample grass so the ground becomes compacted, exposed and subject to erosion; exposed and wounded roots can dry out and attract insects and diseases

____ 8. Remove the bark to eat the cambium, a major part of their diet

____ 9. Eat seeds, seriously damaging seed crops and reducing reproduction

___ 10. Eat roots, especially in machine-planted plantations; can eradicate an entire plantation

a. Beavers
b. Big cats
c. Birds
d. Browsers
e. Burrowers
f. Elephants
g. Gophers
h. Grazers
i. Hogs
j. Bears
k. Porcupines
l. Rabbits
m. Raccoons
n. Rodents
o. Snakes

OBJECTIVE 10

Complete statements about methods of animal control.

1. The most effective method for controlling domestic grazing is to graze only the ______________ and ______________ of animals that will maintain a desirable balance in the ecosystem.

2. Increasing the available ________________ enables wildlife to spread out through the forest.

3. ________________ can be increased by planting game food mixtures along logging roads and in planned patches.

4. Small ________________ can be built to hold back seepage or runoff water from slopes in places where there are long distances between sources of water.

5. Where there are many deer or other browsers, logging, stand improvement, or thinning activities can be scheduled for ________________ when the animals are most in need of food.

OBJECTIVE 11

Choose the best word or phrase to complete statements about air pollution and other damage. Circle the correct answers. Some items will have more than one correct answer.

1. Trees can be injured by absorbing pollutants in the process of photosynthesis. Pollutants may be in the form of _______ .

   a. salts and gases

   b. gases and particles

   c. acid rain and salts

   d. particles and acid rain

2. Scientists believe that a combination of factors play a part in whether a tree dies or survives. Some of these factors are _______ .

   a. moisture and host

   b. root systems and environment

   c. host and environment

   d. environment and foliage

3. The parts of trees that suffer the most damage from air pollution are the _______ .

   a. needles of conifers

   b. leaves of hardwoods

   c. root systems of both

   d. nutrient transportation system

4. Acid rain and toxic wastes _______ .

   a. acidify the soil and intensify insect attack

   b. are created by industrialization and acidify the soil

   c. make trees susceptible to bacterial and viral infections

   d. defoliate trees and deteriorate the cambium

5. Improper nutrition affects all of the following EXCEPT _______ .

   a. growth rate

   b. seed production

   c. foliage

   d. pollination

   e. resistance to disease and insects

6. Salt damage to soil, foliage and water is caused by all of the following EXCEPT _______ .

   a. frozen sea water

   b. ocean spray

   c. road salt

   d. sea salt

OBJECTIVE 12

Select from a list true statements about logging damage. Write an "X" in the blank before each true statement.

____ 1. All roads cause a major erosion problem.

____ 2. Building roads compacts soil and destroys root systems.

____ 3. Fungi are spread by burning slash piles.

____ 4. Damage occurs mainly to the trees selected for cutting.

____ 5. Equipment compacts the soil.

____ 6. Soil damage from compaction is negligible.

____ 7. Leaving exposed wood is a major problem because the wood dries out and loses value.

____ 8. Logging debris deposited in streams or bodies of water can impair the water quality, harming fish and wildlife.

____ 9. Operating equipment on the forest floor can cut, scrape, and crush roots.

___ 10. Pushing a tree into a leaning position against another tree forms an undesirable reaction wound like a callous on human skin.

___ 11. Reaction wounds are unattractive, but do no real damage.

___ 12. Some damage is inevitable in any logging operation.

___ 13. Standing trees are wounded during felling and skidding.

___ 14. The loss of regeneration from logging damage is a minor problem.

___ 15. Trees that hinder logging operations are often cut, broken, crushed, or have the bark scraped off.

NOTICE The following assignment sheets are not part of the written test. If these activities have not been completed, check with your instructor.

OBJECTIVE 13 **Identify insects from a description of damage.** SCORE ________

OBJECTIVE 14 **Identify insect damage from collected samples.** SCORE ________

OBJECTIVE 15 **Make a chart of major tree diseases.** SCORE ________

OBJECTIVE 16 **Report on damage from natural and manmade causes.** SCORE ________

WRITTEN TEST ANSWERS

IDENTIFY TYPES OF FOREST DAMAGE

XV

OBJECTIVE 1

1. f
2. l
3. j
4. p
5. e
6. m
7. n
8. g
9. o
10. a
11. k
12. d
13. x
14. bb
15. w
16. s
17. t
18. v
19. u

OBJECTIVE 2

- Reduced growth
- Damaged and deformed timber
- Seed and reproduction losses
- Lost revenues
- Time, manpower, money, and research invested in prevention and control

OBJECTIVE 3

1, 2, 4, 7, 8, 10

OBJECTIVE 4

1. b
2. c
3. d
4. a
5. b
6. a
7. d
8. b
9. c
10. b
11. a
12. a

OBJECTIVE 5

1. Tip feeders
2. Bark beetles
3. Seed insects
4. Sap suckers
5. Leaf eaters
6. Wood borers
7. Root feeders
8. Bark beetles
9. Gall makers
10. Leaf eaters

OBJECTIVE 6

1. e
2. a
3. h
4. j
5. g
6. c
7. m
8. k
9. d

OBJECTIVE 7

1, 2, 3, 5, 7, 10, 11, 12, 13

OBJECTIVE 8

Answer may include any seven of the following:

- Drought is a prolonged dry period when soil moisture is so low that tree growth slows or stops until there is sufficient moisture or until the tree dies.
- High temperatures (above 120-130° F., 49-54° C.) can cause the death of seedlings.
- Sunscald overheats and damages the cambium tissue, causing permanent wilting in young leaves and in southern trees with thin barks.
- High winds, such as hurricanes or tornadoes, damage both softwoods and hardwoods, particularly in overcut pine stands. Young and mature trees are uprooted and windthrown. If not removed, there is no reproduction under the felled trees.
- Ice does the most serious damage. Young, even-aged stands suffer the most damage because the interlacing branches hold large quantities of glaze ice and snow. Trees can be crushed, bent to the ground, and trunks or crowns can be permanently twisted.
- Severe hail can knock down limbs and trees, and can completely defoliate limbs and leaders.

- Freezing can kill seedlings outright (called winterkill) or cause cankers. Large trees can be winterkilled if the buds or leaves are destroyed by heavy frosts in early fall or late spring.

- Flooding will damage trees if the water stands for a prolonged period.

- Lightning generally hits the tallest and best trees in the stand. If the tree is not killed outright, damage to the bark leaves them open to insects and diseases.

OBJECTIVE 9

1. a
2. f
3. i
4. k
5. d
6. l
7. h
8. j
9. n
10. g

OBJECTIVE 10

1. numbers, types
2. water supply
3. food supply
4. ponds
5. mid- or late winter

OBJECTIVE 11

1. b
2. c
3. a
4. b
5. d
6. a

OBJECTIVE 12

2, 5, 8, 9, 10, 12, 13, 15

OBJECTIVE 13

Refer to answers to Assignment Sheet 1.

OBJECTIVE 14	Refer to answers to Assignment Sheet 2.
OBJECTIVE 15	Refer to answers to Assignment Sheet 3.
OBJECTIVE 16	Refer to answers to Assignment Sheet 4.

OBJECTIVE SHEET

IDENTIFY PRINCIPLES OF FOREST UTILIZATION

XVI

INTRODUCTION

Growing timber is an extensive form of land use. Investments and expenditures must be made carefully and intelligently because of the length of time between investment and return, 15-50 years. Wise utilization and good management, including soil and water conservation practices, are the keys to a successful and profitable enterprise.

PREREQUISITES

Unit V: *Identify Forest Trees*
Unit VIII: *Use Basic Math for Forestry*
Unit IX: *Practice Tree Measurement*
Unit XII: *Cruise Timber Stands*

UNIT OBJECTIVE

After completing this unit, the student should be able to identify utilization practices, discuss marketing for the highest return, and be able to apply certain utilization practices. The student will demonstrate these competencies by completing the assignment sheets, a job sheet, and written test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Define terms associated with principles of forest utilization.
2. Determine the party responsible for different aspects of management.
3. Create a scenario of a day in the forest that includes six nonconsumptive uses of the forest.
4. List marketing practices for selling for the highest return.
5. List specialty markets.
6. Select from a list usual considerations found in a sales contract.
7. Identify potential markets. (Assignment Sheet 1)
8. Determine local timber prices. (Assignment Sheet 2)
9. Demonstrate the ability to determine the highest value of a timber stand. (Job Sheet 1)

IDENTIFY PRINCIPLES OF FOREST UTILIZATION

PREPARATION

- Obtain materials to supplement unit.

  NOTE: See Suggested Resources.

- Review instructional outline for this unit. Modify time frames to suit class needs and plan activities for each class period.

- Study the specific objectives to determine those you will cover in your presentation. Decide also which objectives should be taught to which students.

- Determine scope and sequence of objectives that you add. Design and develop support materials, including evaluation techniques, for additional objectives.

- Determine how you will schedule time for students to demonstrate competence in the required procedures.

  NOTE: Assignment Sheets 1 and 2 must be completed before the Job Sheet.

- Arrange for a trip to a timber stand to complete Job Sheet 1.

- Invite a forester, consultant, or a contractor to discuss the business aspects of forestry and timber growing.

- Invite a forester, timber-growing landowner, consultant, and a contractor to discuss (1) their objectives and responsibilities, (2) marketing for the highest return, and (3) bidding and contracting.

- Invite a forester and an attorney to talk about important points in a contract.

  NOTE: Supply guest speakers with the specific objectives and other appropriate sections of the unit.

DELIVERY

Objective 1

- Invite a forester, consultant, or contractor to discuss the business aspects of growing and selling timber.
- Review terms with students. Remind students that in this unit they must define the terms, rather than match them to their definitions.

Objective 2

- Discuss nonconsumptive uses of the forest.
- Let the class create "a day in the forest" in which the activities or observations reflect nonconsumptive uses.
- Draw on students' own experiences with nonconsumptive uses to develop an appreciation for these values, particularly for the social and aesthetic values of the forest.

Objectives 3 and 4

- Discuss the party responsible for different aspects of management and marketing for the highest value.
- Invite a panel of a forester or consultant, a timber-growing landowner, and a contractor to discuss their various roles and responsibilities. Have them discuss marketing for the highest return.

  NOTE: You may add some of the items in their discussion to the test questions.
- Compare timber sales made by brokers and hired labor with other agricultural enterprises in your area.

Objective 5

- Discuss specialty markets.
- Make a copy of *Forest Industries Buyer's Guide* for your state available to students.
- Discuss specialty items found in your classroom and in the home.
- Discuss local specialty products and markets.
- Have students complete Assignment Sheet 1.

Objective 6

- Invite an attorney to discuss contracts.
- Discuss the legality of sales contracts.
- Provide for comparison a variety of contracts, available from your local extension office.
- Discuss the considerations found in a sales contract.
- Go over the sales contract with the students and discuss how parts of the contract affect the seller and the buyer.
- Have students complete Assignment Sheet 2.

APPLICATION

Objective 7

- Use Assignment Sheet 1 to help students identify potential markets.
- Provide each student with a map of your state.
- Review using map scale from Unit 8, *Use Basic Math for Forestry*, if needed.
- Provide copies of your state's *Forest Industries Buyer's Guide*.
- Discuss markets in surrounding states.
- Find out where wood products from your area are exported and discuss transportation.

Objective 8

- Use Assignment Sheet-2 to give students practice in gathering price information.
- Emphasize that most transactions and prices are set through a bidding process.

Objective 9

- Use Job Sheet 1 to give students an opportunity to practice marketing for the highest value and to use math and estimating skills.

- This job sheet combines many of the skills students have learned in other units: Cruising, measurement, tree identification, evaluating the best use of trees, determining volume, and dollar value.

EVALUATION

Practical test

- Explain to students that they will be asked to demonstrate procedures on the job sheets to complete the practical test.
- Describe the rating scale used on the practical test.
- Give practical test.
- Reteach and retest as necessary.

Written test

- Explain to students that they will be asked to demonstrate on the written test actions listed in the specific objectives.
- Give written test.

  NOTE: The written test may be given in sections if desired.
- Evaluate students on assignment sheet activities if not previously done.
- Reteach and retest if necessary.
- Complete appropriate section of competency profiles.
- Review individual and group performance in order to evaluate teaching methods. Adjust scope, sequence, or instructional approaches for additional lessons as required.

SUGGESTED RESOURCES

Speakers

Oklahoma Natural Resources Speakers Bureau sponsored through Oklahoma State University, Division of Agriculture, Oklahoma Cooperative Extension Service - Forestry, Oklahoma Conservation Commission and the Oklahoma Forestry Association. Lists speakers on a variety of forestry-related topics. Speakers operate on a time-available basis. Request a listing of speakers, programs, slide presentations and videotapes from your local extension office or from:

Dr. Steve Anderson
Forestry Dept.
Oklahoma State University
239 Agricultural Hall
Stillwater, OK 74078
(405) 744-9431

Dave Marcouiller
Forestry Dept.
Oklahoma State University
242 Agricultural Hall
Stillwater, OK 74078
(405) 744-5444

Teachers outside of Oklahoma should contact the Forestry Extension Office in their state.

Audiovisual Materials

The following materials are available on a free-loan basis from the Forestry Extension Program at Oklahoma State University, 242 Agricultural Hall, Stillwater, OK 74078, (405) 744-5444 or 744-9431.

- *The Un-Pine Forest*, 102 slides with cassette, USDA Forest Service and the Southern Hardwood Lumber Manufacturers Association. Describes the Southern Hardwood Resource from a utilization standpoint.
- *Marketing Timber, A Guide for Private Woodland Owners*, 18:10 min, VHS, Minnesota Extension Service. Describes the important considerations of marketing timber from private woodlands. Outlines the procedures involved in selling timber.

Other media

- State *Forest Industries Buyer's Guide*.
- State map for each student.
- Sample sales contracts.

  NOTE: These should be available from your county extension office.

UNIT REFERENCES

- Anderson, David A. and I. I. Holland, *Forests and Forestry*, The Interstate Printers & Publishers, Inc., Danville, Illinois, 1982.
- Blinn, Charles R. and Lewis T. Hendricks, *Marketing Timber from the Private Woodland*, Agricultural Extension Service, University of Minnesota, 1985.
- *Harvesting Forestry Products*, Texas A & M University, College Station, Texas, 1976.

INFORMATION SHEET

IDENTIFY PRINCIPLES OF FOREST UTILIZATION

XVI

OBJECTIVE 1

Define terms associated with principles of forest utilization.

- **Compliance**—The inspection of an on-going timber sale to check for adherence to the terms of the contract
- **Management prescriptions**—Recommended practices for a specific tract of land, according to specific objectives
- **Offeree**—The one who accepts the proposal
- **Offeror**—The one who proposes the sale

OBJECTIVE 2

Determine the party responsible for different aspects of management.

Usually the forest management team is made up of the landowner, the forester or consultant, and a contractor. Sometimes the landowner may also do the labor that a contractor would do, or sometimes the consultant is also the contractor. Well-informed landowners can cruise the property, set goals, define activities, and do the labor themselves.

Landowner—Makes sure that

- Future goals of forest lands are specified in a management plan
- Management activities are identified to meet the plan

  EXAMPLE: Harvesting activities, thinning, restocking with high-value, genetically improved seedlings
- All harvesting activities are done with the idea of working toward the stated goals
- Management objectives are met

  EXAMPLE: Provides money and labor to implement the plan
- He or she finds out which products are in greatest demand
- Timber to be cut is marked

Forester or consultant

- Works for the landowner to accomplish the stated goals
- Cruises the property
- Advises and assists landowner in identifying objectives
- Writes management prescriptions to meet objectives
- Can make decisions and take action in place of the landowner

Contractor

- May work for the landowner or the consultant
- Provides labor and equipment to implement the plan

OBJECTIVE 3

Create a scenario of a day in the forest that includes six nonconsumptive uses of the forest.

NOTE: A scenario is like a case study. You might write about what you see on a field trip or write as though you were a ranger in a national forest. What you see or what you do must be examples of the uses described below.

- **Recreation**—Hunting, fishing, hiking, canoeing, camping, birdwatching, photography, etc.
- **Education**—Helping people understand nature, ecology, botany, biology; learn to identify plants, trees and animals; learn about wildlife and their habitats; learn outdoor survival techniques.
- **Research**—Finding better ways to use and manage forest-related resources; to protect the forest from insects, diseases, and fires; to develop high-quality, fast-growing stock; to help maintain a good ecological balance; to improve the financial return to the landowner.
- **Aesthetic**—Having available and experiencing the psychological, emotional, and spiritual benefits of the forest: its beauty, natural balances, and processes. The variety of colors, sounds, smells, and textures are a source of inspiration, renewal, and enrichment.

- **Wildlife**—Maintaining the balance of nature by feeding on various life forms while living and by adding organic materials to the soil when dead; they provide an aesthetic stimulus and sense of the "natural order."

- **Environmental uses**—Contributing to clean water, clean air, serving as a buffer for air and noise pollution, contributing to the worldwide ecological and environmental balance.

OBJECTIVE 4

List marketing practices for selling for the highest return.

The basic principle for marketing for the highest return is to sell all products produced in a stand at the highest possible value. The seller should find a market for all the products according to their value. In a timber sale for pine where half the volume in the stand is sawlog material and half is pulpwood, the seller should not sell the whole batch as pulpwood. Nor should quality walnut be sold for pallets.

Marketing practices for selling for the highest return

- Marking and estimating timber according to the products

  EXAMPLES: Sawlogs, posts, pulp, chips, veneer

- Selling the timber for the highest-value products first

- Offering timber to several buyers on a bid basis

  NOTE: A sealed bid process is often used.

- Selling the timber under specific terms of a written contract

OBJECTIVE 5

List specialty markets. (Assignment Sheet 1)

Many wood products call for specific woods because of the qualities the wood can bring to the product. These are specialty markets. A good consultant or forester knows what and where the specialty markets are and the value of the timber they want to buy.

- High-value hardwoods and cedar for specific products

  EXAMPLES: White oak for whiskey kegs (tylosis crystals fill the large, open cells making the wood leakproof)
  Persimmon for golf club heads (extremely hard wood, having high impact strength)
  Cherry for furniture (beautiful grain and color)
  Western redcedar for outdoor construction (resists rotting and splitting)
  Cedar chips for mothproofing (highly aromatic)
  Ash, oak and hickory for handles

- Low-value hardwoods and softwoods for railroad ties

- Veneer for hardwood paneling

- Hardwood structural timber for furniture

- Logs for growing mushrooms

  EXAMPLES: White oak, sweetgum

- Christmas tree production

- Mistletoe production

- Gums and tannins used in paints, cosmetics, medicines, and plastics

- Shavings used for animal bedding

- Bark used for landscaping

- Others in your area

  ____

  ____

  ____

  ____

  ____

  ____

OBJECTIVE 6

Select from a list usual considerations found in a sales contract. (Assignment Sheet 2, Supplements 1 and 2)

Sales contracts vary greatly in how specific or general they are. They should state the obligations of each party and generally contain the information listed below. Contracts are made from the offerer to the offeree. Terms of the contract are guaranteed through compliance. A *Sale Contract Compliance Inspection Summary* is a written record of the work completed, damages, and other considerations.

- Names of buyer and seller
- Description of property and location
- Price and method of payment based on products and units of measure

  EXAMPLE: Doyle log rule
- An understanding that trees will be marked at eye and ground level
- An agreement that trees will be utilized to lowest top diameter
- Guarantee of protection against fire and excessive logging damage

  EXAMPLES: Tree damage, stream damage, erosion, etc.
- Written penalties for taking or damaging unmarked trees
- Guarantee of cleanup and condition of property
- Guarantee of insurance to comply with workman's compensation and liability laws
- Specific beginning and termination dates
- The title of the timber guaranteed by the seller
- Access to the timber guaranteed by the seller
- Prohibition against the buyer reassigning the contract without written consent of the seller
- Provision for settling disputes, agreed to by both parties

  EXAMPLE: Each party will have one forester and one representative.

- Special stipulations are clearly stated
- Right of termination with written notice

Woodland Owner
Sample Timber Sales Contract

THIS AGREEMENT made and entered into this _____ day of _________________, 19___, between ____________________________, of _______________________, Minnesota, hereinafter called the Seller, and _______________, of ___________________, Minnesota, herinafter called the Purchaser.

WITNESSETH:

SECTION I. The Seller agrees to sell and the Purchaser agrees to buy, under the terms and conditions hereinafter stated, all the timber marked or designated by the Seller, estimated to be _________________ more or less, on certain lands held by the Seller and described as follows: ________ acres in Section ________, Township ________, Range ________, County of _____________, State of Minnesota.

SECTION II. The Purchaser agrees to pay the Seller the sum of _________ Dollars ($_________), more or less, as may be determined by actual scale at the rate of

____

____

____

____

SECTION III. The Purchaser agrees to pay the Seller a mutually agreed upon installment in advance of cutting. The first installment of _________ Dollars ($_________) shall be paid when the contract is signed, and subsequent installments shall be paid on or before such time as the value of the timber previously cut is equal to the total payments actually made.

SECTION IV. The Purchaser further agrees to cut and remove said timber in accordance with the following conditions:

1. All designated or marked timber shall be cut and removed on or before ___________, 19 ____, unless extension of time is requested and granted in writing.
2. Cutting regulations to be followed when timber is not marked:____ ____
3. Sawtimber will be scaled by the Scribner Decimal C log rule, and for a sawtimber measured at the small end of the log along the average diameter inside the bark, and for veneer logs measured at the small end of the log along the small diameter inside the bark.
4. Whenever any unmarked trees or undesignated trees are cut, the Purchaser shall pay for them at a rate not exceeding three (3) times their scale.
5. Immature and unmarked trees shall be protected against unnecessary injury.
6. Stumps shall be cut so as to cause the least waste; stumps of trees up to _____ inches in diameter should not be higher than twelve (12) inches above the ground, and those of trees above this size should be cut at a distance above the ground not greater than three-fourths (3/4) the stump diameter.
7. Only designated dead or unmerchantable species may be used for construction purposes in connection with the logging operation.
8. All roads shall be located so as to avoid stands of young timber.
9. Care shall be exercised at all times by the Purchaser or his agents against the starting and spread of fire. Any fires caused by the Purchaser or his agents shall be suppressed by the Purchaser at his own expense and the Purchaser agrees to pay for all damage caused by such fire.
10. The Purchaser agrees to repair immediately, at his own expense, damage caused by the Purchaser or his agents to roads, gates, fences, bridges, or other improvements on the Seller's property.
11. Only merchantable products specified in SECTION II shall be removed by the Purchaser.
12. All trees shall be utilized to a minimum top diameter inside the bark or _____ inches, unless defect resulting from decay or branching otherwise limits merchantability.
13. SPECIAL STIPULATIONS: ____ ____ ____ ____

SECTION V. It is mutually understood and agreed by and between the parties hereto as follows:

1. All timber included in this agreement shall remain the property of the Seller until paid for in full. Merchantable wood left unhauled at the expiration of this contract, or any extension thereof, shall be paid for by the Purchaser at the regular rate.
2. The Seller guarantees that he/she has full right and title to the timber included in this sale.
3. This agreement shall not be assigned in whole or in part by either hereto without the written consent of the other party.
4. The Seller may stop all operations for violation of any term of this contract by the Purchaser, and for cause may retain all monies deposited to the Seller.
5. In case of dispute over the terms of this contract, final decision shall rest with a reputable person to be mutually agreed upon by the parties to this contract: and in case of further disagreement, the final decision shall rest with an arbitration board of three (3) persons, one to be selected by each party to this contract and a third to be selected by the other two members.
6. The Purchaser shall remove all equipment and structures used during the operation within ninety (90) days after completion of this contract. If not removed, the items remaining become the property of the Seller.
7. The Purchaser shall save and hold the Seller (Landowner) harmless from any and all liability arising from the Purchaser's action or use and occupancy of Seller's property.
8. SPECIAL STIPULATIONS: ____
____
____
____
____
____

IN WITNESS WHEREOF, the Parties hereto have hereunto set their hands and seals on this______ day of _______, 19 ___.

______________________________ (Witness)

______________________________ (Seller)

______________________________ (Witness)

______________________________ (Puchaser)

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SAMPLE SALE CONTRACT COMPLIANCE INSPECTION SUMMARY

UNCUT MARKED TREES			
SPECIES	DBH	NO. LOGS	VOL. MBF/ CUFT

CUT TREES/LOGS LEFT			
SPECIES	DBH/ DIB	LGTH	VOL. MBF/ CUFT

TREES DAMAGED				
SPECIES	DBH	VOL.	HT.	KIND

NUMBER OF 1/5 ACRE PLOTS CHECKED __________ = ACRES INSPECTED __________

STUMP HEIGHT			
NO. OK		NO. TOO HIGH	
S.T.	P.W.	S.T.	P.W.

WASTE-LONG BUTT & TOP, BREAKAGE				
SPECIES	DIB	LGTH	VOLUME MBF/ OR CUFT	BUTT (B) TOP (T) BREAK (BR)

UNCUT MARKED TREES			
SPECIES	STUMP DBH	NO. LOGS	VOL. MBF/ CUFT

1. Sale designation ____________________
(Forest, Compartment, Purchaser, Date)
2. Date of inspection __________ payment unit ________ percent of unit completed __________
3. Summary of the sale area conditions as reported or noted prior to inspection from previous inspections or "spot checks"
____
____
4. Previous action taken to secure contract compliance: Oral ________ Written ________
By ____________________ To ____________________ __________
(Forest Officer) (Company Representative) (Date)
Nature of requested compliance: ____________________
____
5. Complaints registered by purchaser ________ ____________________
(Date) (Nature of complaint)
____
(Cite action taken to settle - when taken, who with, written or verbal, etc. and results)
____
6. Condition found (based on systematic inspection, strip located on sale area map):
   A. Cutting operation: Length of 1 chain strip __________ chains= __________ acres inspected: __________
   B. Log Making: (normal) (long log) or (tree length)
      1. Average trim allowance as cut ________ inches
      2. Number logs measured ________ number exceeding trim allowance ________
   C. Condition of marking paint

7. Roads

A. Are temporary logging roads, skid trails, and log landings constructed, maintained and laid-by in accordance with contract specifications? (If "no", explain) ______

B. State progress and compliance with contract specifications, of specified road construction ______

C. Is purchaser doing his own required share of system road maintenance, is he performing in accordance with a written agreement defining "his share"? (If "no", explain) ______

8. Erosion control

A. Seeding done as required? (If "no", explain) ______

B. Are mill sets, camps, etc., properly laid-by after abandonments? (If "no", explain) ______

9. Slash disposal — are slash disposal requirements being met currently? (If "no", explain) ______

10. Fire control:

A. Have mill sites and camps been fire-proofed; are safe arrangements for slab and sawdust burning in effect? (If "no", explain) ______

B. Has purchaser met other contractual fire prevention and control requirements? ______

11. Consumer return scale:
Any observation on sale area leading to question on reliability of consumer returns: ______

12. Other: Adequacy of purchaser supervision, sanitation, safety practices, payments, etc. ______

13. Summary of action required of purchaser to meet requirements for acceptance ______

14. Follow-up action: Oral with ______ (Name of company representative) ______ (By) ______ (Date)

______ (Results)

Written to ______ (Purchaser) (By) (Date) (Results)

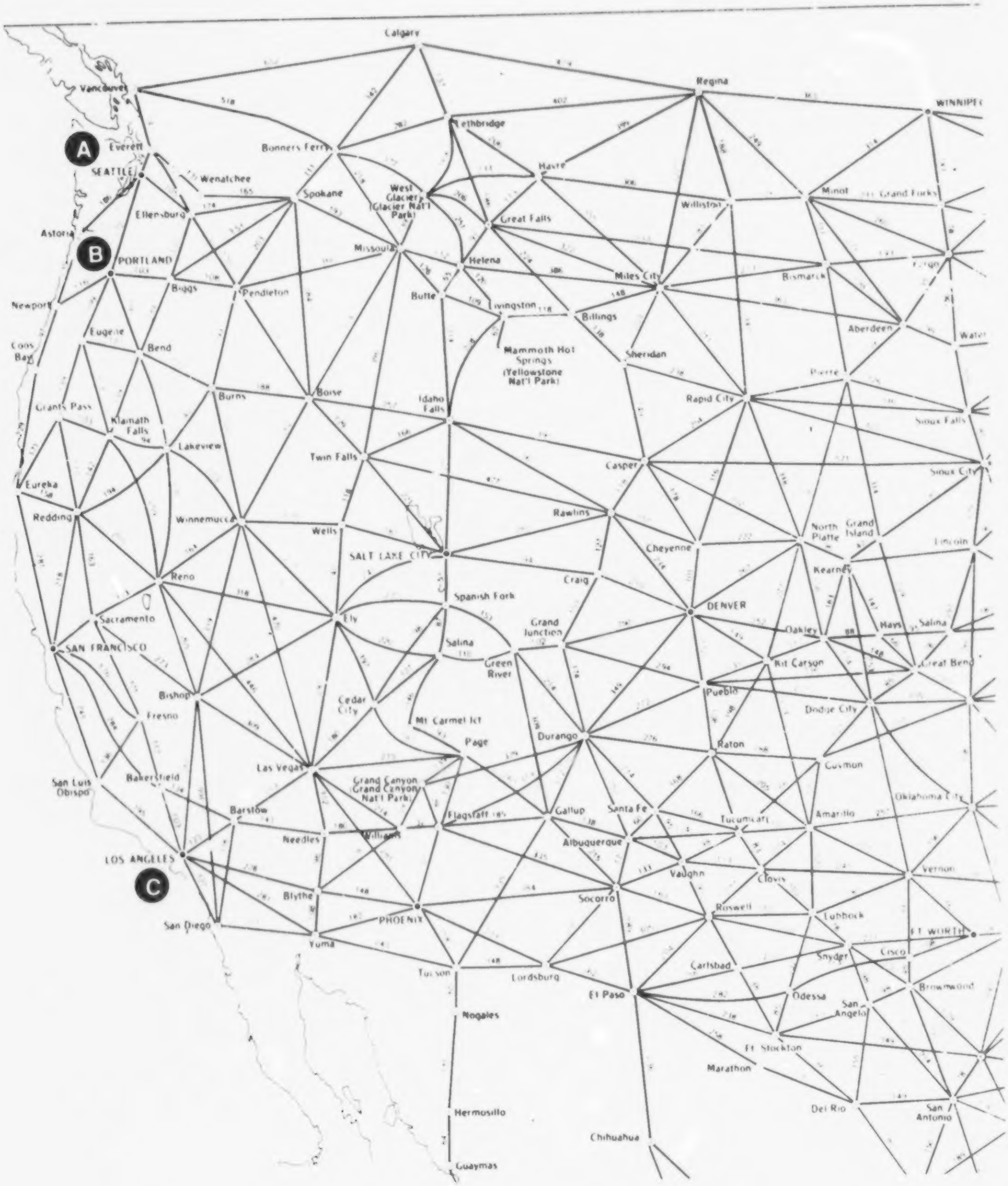
15. Submitted: ______ (Date) By ______ (Forest officer) Reviewed & Approved ______ (Date) By ______ (District Ranger)

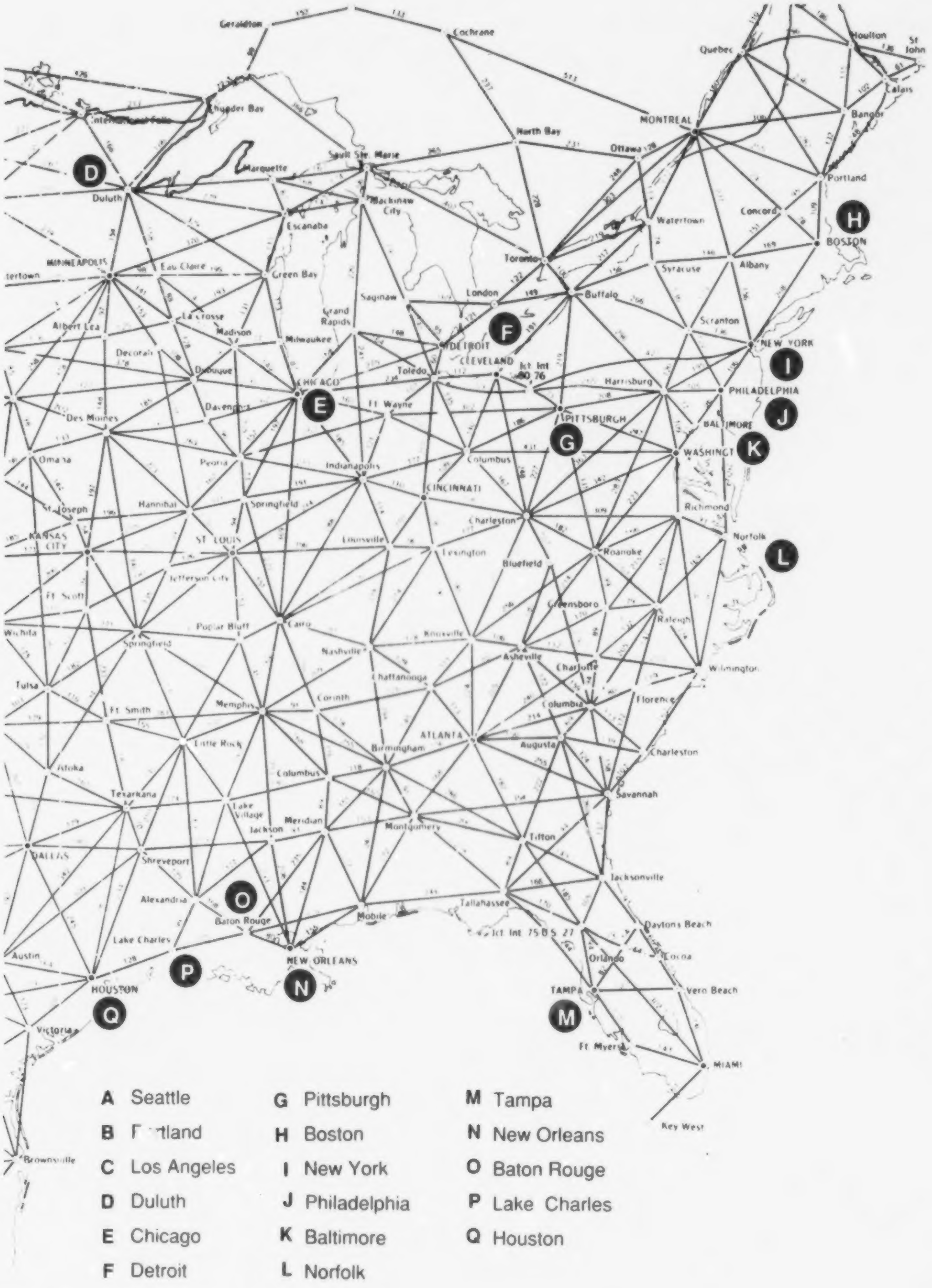
16. Final spot check ______ (Date) By ______ (Forest officer)

17. Payment unit accepted ______ (Date) ______ (District ranger) Notification of Purchaser in Writing ______

MAP OF THE U.S. WITH MAJOR HARBORS

Harbors play an important role in trade; they enable goods to be shipped to places where they can be sold and used. There are many harbors in the United States; ranging from small boating harbors to large harbors which serve as a contact point for international trade. There can be inland harbors such as the Port of Catoosa in Tulsa, Oklahoma. The map on the following pages shows the major harbors of the United States.


A
B
C
Calgary
Regina
WINNIPEG
Vancouver
Everett
SEATTLE
Wenatchee
Ellensburg
Astoria
PORTLAND
Biggs
Newport
Coos Bay
Eugene
Bend
Grants Pass
Klamath Falls
Lakeview
Eureka
Redding
Winnemucca
Reno
Sacramento
SAN FRANCISCO
Bishop
Fresno
San Luis Obispo
Bakersfield
Barstow
Needles
LOS ANGELES
San Diego
Blythe
Yuma
Bonners Ferry
Spokane
Pendleton
Burns
Boise
Lethbridge
West Glacier (Glacier Nat'l Park)
Missoula
Helena
Great Falls
Havre
Butte
Livingston
Mammoth Hot Springs (Yellowstone Nat'l Park)
Billings
Idaho Falls
Twin Falls
Wells
SALT LAKE CITY
Spanish Fork
Ely
Salina
Cedar City
Las Vegas
Mt Carmel Jct
Page
Grand Canyon (Grand Canyon Nat'l Park)
Williams
Flagstaff
PHOENIX
Tucson
Nogales
Hermosillo
Guaymas
Lordsburg
Williston
Miles City
Sheridan
Casper
Rawlins
Cheyenne
Craig
Grand Junction
Green River
Durango
Gallup
Santa Fe
Albuquerque
Socorro
El Paso
Chihuahua
Minot
Grand Forks
Fargo
Bismarck
Aberdeen
Pierre
Rapid City
Sioux Falls
Sioux City
North Platte
Grand Island
Kearney
Lincoln
DENVER
Oakley
Hays
Salina
Kit Carson
Great Bend
Pueblo
Dodge City
Raton
Guymon
Amarillo
Tucumcari
Vaughn
Clovis
Roswell
Lubbock
Oklahoma City
Vernon
FT WORTH
Cisco
Snyder
Brownwood
Carlsbad
Odessa
San Angelo
Ft Stockton
Marathon
Del Rio
San Antonio
Waterto


A Seattle
B Portland
C Los Angeles
D Duluth
E Chicago
F Detroit
G Pittsburgh
H Boston
I New York
J Philadelphia
K Baltimore
L Norfolk
M Tampa
N New Orleans
O Baton Rouge
P Lake Charles
Q Houston

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ASSIGNMENT SHEET 1

IDENTIFY PRINCIPLES OF FOREST UTILIZATION

XVI

NAME ______________________________ SCORE ________

OBJECTIVE 7 **Identify potential markets.**

INTRODUCTION

One of the more important considerations for the landowner, forester, consultant, and logger is, "Where will I sell the timber to get the highest value?" The major factor is transportation—what markets are within economical transport distance from the timber stands?

Economical distance is determined by the value of the product and the demand. The following are examples of markets:

Pulp/paper mill
Post mill
Saw mill
Specialty markets
Export markets
Firewood sales

DIRECTIONS

Provide the information requested for each item. Your instructor may ask that you include additional information about markets and products found in your area. Review map and scale in Unit VIII, *Use Basic Math for Forestry.*

1. On a map of your state, mark a radius around where you live for each of these products:

   50-mile radius for pulpwood

   100-mile radius for sawlogs

   200-mile radius for specialty products

2. List the markets you already know about within this area.

   ____

   ____

   ____

   ____

   ____

   ____

   ____

3. Using the USDA *Forest Industries Buyer's Guide* for your state, or other sources, identify all the mills within these distances.

____

____

____

____

____

____

4. Using the map of harbors in Supplement 3, determine whether or not logging operations located near the cities below could realistically export timber, based on a 500 mile transport distance.

   Add the mileage between cities to determine and indicate which port, if any, is within 500 miles of these logging sites.

   a. Atoka, Oklahoma ______________________________

   b. Missoula, Montana ____________________________

   c. Twin Falls, Idaho ______________________________

5. Identify specialty markets in your state.

____

____

____

____

____

____

____

____

____

____

____

____

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6. Identify three potential markets for firewood in your area, in amounts of five cords or more.

____

____

____

____

____

____

____

____

____

____

____

____

____

1120

NAME ______________________________ SCORE _______

OBJECTIVE 8 **Determine local timber prices.**

INTRODUCTION

The landowner, the forest consultant and the contractor are interested in the best use of the timber and in marketing for the highest value. Knowing what buyers are giving for timber is critical to the success of any forestry operation.

Call your county extension office to find out about markets and prices.

DIRECTIONS

Work in groups and divide the research accordingly.

1. List marketable species in your area on the chart on page 28.
2. Write down your assignment and complete the information required on page 28.
3. List sources used by the whole class.
4. When the research has been completed, fill in the chart on page 28. List for your area:

	Price per ton/bd ft/cu ft			
Species	Sawlogs	Post	Pulp	Chips

Include specialty markets for trees in your area.

Prices will vary according to who buys it, who cuts it, and where it will be sold.

Your assignment ______________________________

Your contacts and resources

____

____

Other contacts and resources

____

____

Timber prices

	Price per ton/bd ft/cu ft			
Species	Sawlogs	Post	Pulp	Chips

ASSIGNMENT ANSWERS

IDENTIFY PRINCIPLES OF FOREST UTILIZATION XVI

ASSIGNMENT SHEET 1

NOTE: The purpose of this assignment sheet is to emphasize the relationship between transport distance and marketability, and to reinforce understanding of market resources and wood products. Answers are general and relative to your own location.

1. Map should be marked in 50, 100 and 200-mile radii according to the scale.
2. No evaluation required; students list current knowledge
3. List should include all mills within the area. You may request additional information such as products manufactured.
4. a. Baton Rouge, Louisiana

   Houston, Texas

   Lake Charles, Louisiana

   b. Seattle, Washington

   c. None
5. Answer should include specialty markets in your state.
6. Answer may include local wood lots, major consumers such as a restaurant that burns wood for atmosphere, owners of large wood-heated homes, newspaper advertising, etc.

ASSIGNMENT SHEET 2

Students should use this assignment sheet to establish a resource list. Chart should list species and sawlog, post, pulp and chip prices.

JOB SHEET 1

IDENTIFY PRINCIPLES OF FOREST UTILIZATION

XVI

OBJECTIVE 9

Determine the highest value of a timber stand.

TOOLS AND MATERIALS

- Diameter tape
- Clinometer or altimeter
- Steel tape
- Tally sheet
- Pencil
- Tree identification key
- Volume tables
- Information from Assignment Sheets 1 and 2

INTRODUCTION

Your objective will be to perform a 100% cruise in a small area identified by your instructor. Assume that your assignment will be to clear cut the area and to get the highest market value for all timber in the stand.

PROCEDURE

1. Perform a 100% inventory on the selected site. Record results on pages 33 and 34.
   a. Identify all trees
   b. Determine size
   c. Determine marketability according to size and condition

   NOTE: Note quality hardwoods and trees for specialty markets.
2. Determine the volume or tonnage, according to how timber is sold in your area, for sawlogs, posts, and pulp for hardwoods and softwoods.
3. Complete the chart on page 35 to determine the highest value of the stand. Use the information from Assignment Sheet 2.
4. Determine where the timber will be sold and enter buyer's name or mill name in the chart.
5. Have your instructor check your work.
6. Put away tools and materials and clean the work area.

Tally Sheet

SOFTWOODS	Sawlogs Diameter Height	Posts Diameter Height	Pulp Diameter Height

Tally Sheet

HARDWOODS	Sawlogs Diameter Height	Posts Diameter Height	Pulp Diameter Height

SOFTWOODS

	Total volume or tonnage x	Price =	Value	Buyer
Sawlogs				
Posts				
Pulp				
Specialty timber				

HARDWOODS

	Total volume or tonnage x	Price =	Value	Buyer
Sawlogs				
Posts				
Pulp				
Specialty timber				

What would the value of the stand be if you sold the entire stand for pulpwood? ______________________

How much more will you make selling for the highest value?
____

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PRACTICAL TEST 1

IDENTIFY PRINCIPLES OF FOREST UTILIZATION

XVI

JOB SHEET 1

Determine the highest value of a timber stand.

Student's name ______________________ Date __________

Evaluator's name ______________________ Attempt no. _____

Instructions: When you are ready to perform this task, ask your instructor to observe the procedure and complete this form. All items listed under "Process Evaluation" must receive a "Yes" for you to receive an overall performance evaluation.

PROCESS EVALUATION

Evaluator note: Write a check mark in the "Yes" or "No" blanks to designate whether or not the student has satisfactorily achieved each step in this procedure. If the student is unable to achieve this competency, have the student review the materials and try again.

The student:	YES	NO
1. Performed a 100% cruise on the selected site.		
a. Identified all trees.	_____	_____
b. Determined size.	_____	_____
c. Determined marketability according to size and condition.	_____	_____
2. Determined the volume or tonnage, according to how timber is sold in your area, for sawlogs, posts, and pulp for hardwoods and softwoods.	_____	_____
3. Completed the chart on page 35 to determine the highest value of the stand.	_____	_____
4. Determined where the timber would be sold and entered buyer's name or mill name in the chart.	_____	_____
5. Used proper tools correctly.	_____	_____
6. Performed steps in a timely manner.	_____	_____
7. Practiced safety rules throughout procedure.	_____	_____
8. Provided satisfactory responses to questions asked.	_____	_____
9. Put away tools and cleaned work area.	_____	_____

EVALUATOR'S COMMENTS

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See performance evaluation key). A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:

	4 Inventory accurate within +-1%	3 Inventory accurate within +-2%	2 Inventory accurate within +-3%	1 Error exceeded 3%
	4 Correctly identified all trees	3 Correctly identified all but 2 trees	2 Correctly identified all but 3 trees	1 Error exceeded 3 trees
	4 Determined marketability within 1%	3 Determined marketability within +-2%	2 Determined marketability within +-3%	1 Error exceeded 3%
	4 Determined volume within +-1%	3 Determined volume within +-2%	2 Determined volume within +-3%	1 Error exceeded 3%
	4 Determined value within +-1%	3 Determined value within +-2%	2 Determined value within +-3%	1 Error exceeded 3%

EVALUATOR'S COMMENTS

AVERAGE RATING

Evaluator note: To obtain an average rating for the competency profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

PERFORMANCE EVALUATIONKEY

4 - Skilled—Can perform job with no additional training
3 - Moderately skilled—Has performed job during training program, limited additional training may be required
2 - Limited skill—Has performed job during training program; additional training is required to develop skill
1 - Unskilled—Is familiar with process, but is unable to perform job

WRITTEN TEST

IDENTIFY PRINCIPLES OF FOREST UTILIZATION

XVI

NAME ______________________________ SCORE _______

OBJECTIVE 1

Define terms associated with principles of forest utilization.

1. Offeree

____

____

2. Compliance

____

____

3. Offeror

____

____

4. Management prescriptions

____

____

OBJECTIVE 2

Determine the party responsible for different aspects of management. Write an "L" in the blank if the statement describes a responsibility of the landowner. Write an "F" if it describes the responsibility of the forester or consultant. Write a "C" if it describes the responsibility of the contractor.

____ 1. Agrees to cut the cull trees and sell the timber as pulpwood.

____ 2. Decides that forage and hunting are important uses of the land.

____ 3. Estimates the amount of usable timber and its value.

____ 4. Finds out which products are in greatest demand.

____ 5. Identifies sections of land where debris should be burned in a controlled fire.

____ 6. Suggests cutting all trees on one section and leaving seed trees in the adjacent sections.

____ 7. Is hired to build a road into the tract.

____ 8. Makes sure that future goals of forest lands are specifed in a management plan.

____ 9. Can make decisions and take action in place of the landowner

___ 10. Writes management prescriptions to meet objectives.

OBJECTIVE 3

Create a scenario of a day in the forest that includes six nonconsumptive uses of the forest. A scenario is like a case study. You might write about what you see on a field trip, write as though you were a logger or a ranger in a national forest or even as a bird moving through the forest. What you see or what you do must be examples of nonconsumptive uses. Underline each of the six uses as you include them in the scenario.

____

____

____

____

____

____

____

____

____

____

____

____

____

OBJECTIVE 4

List marketing practices for selling for the highest return. Write three marketing practices for selling for the highest return.

OBJECTIVE 5

List specialty markets. Write eight specialty markets.

OBJECTIVE 6

Select from a list usual considerations found in a sales contract. Write an "X" in the blank before each correct statement.

____ 1. Specific beginning and termination dates

____ 2. Prohibition against the buyer reassigning the contract without written consent of the seller

____ 3. Names of buyer and seller

____ 4. Proof of insurance against personal injury or property damage

____ 5. An agreement that trees will be utilized to lowest top diameter

____ 6. Minimum and maximum number of working hours on the job site

____ 7. Price and method of payment based on products and units of measure

____ 8. The title of the timber guaranteed by the seller

____ 9. Description of property and location

___ 10. Guarantee of protection against fire and excessive logging damage

___ 11. Right of termination with written notice

___ 12. Environmental Impact Statement

___ 13. Agreement that the buyer will comply with federal regulations

___ 14. Guarantee that the seller will take no more than a 15% commission

___ 15. An understanding that trees will be marked at eye and ground level

NOTICE The following assignment sheets and job sheet are not part of the written test. If these activities have not been completed, check with your instructor.

OBJECTIVE 7 **Identify potential markets.** SCORE ________

OBJECTIVE 8 **Determine local timber prices.** SCORE ________

OBJECTIVE 9 **Demonstrate the ability to determine the highest value of a timber stand.** RATING _______

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WRITTEN TEST ANSWERS

IDENTIFY PRINCIPLES OF FOREST UTILIZATION

XVI

OBJECTIVE 1

1. The one who accepts the proposal
2. The inspection of an on-going timber sale to check for adherence to the terms of the contract
3. The one who proposes the sale
4. Recommended practices for a specific tract of land, according to specific objectives

OBJECTIVE 2

1. C
2. L
3. F
4. L
5. F
6. F
7. C
8. L
9. F
10. F

OBJECTIVE 3

Answer should include reasonable activities or observations that identify the following nonconsumptive uses:

- Recreation
- Education
- Research
- Aesthetic
- Wildlife
- Environmental uses

OBJECTIVE 4

Answer should include any three of the following:

- Marking and estimating timber according to the products
- Selling the timber for the highest-value products first
- Offering timber to several buyers on a bid basis
- Selling the timber under specific terms of a written contract

OBJECTIVE 5

Answer should include any eight of the following:

- High-value hardwoods and cedar for specific products
- Low-value hardwoods and softwoods for railroad ties
- Veneer for hardwood paneling
- Hardwood structural timber for furniture
- Logs for growing mushrooms
- Christmas tree production
- Mistletoe production
- Gums and tannins used in paints, cosmetics, medicines, and plastics
- Shavings used for animal bedding
- Bark used for landscaping
- Others in your area

OBJECTIVE 6

1, 2, 3, 5, 7, 8, 9, 10, 11, 15

OBJECTIVE 7

Refer to answers to Assignment Sheet 1.

OBJECTIVE 8

Refer to answers to Assignment Sheet 2.

OBJECTIVE 9

Refer to Practical Test Rating for Job Sheet 1.